Presented by

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PUBLIC HEALTH

PAPERS AND REPORTS

VOLUME XX

PRESENTED AT THE TWENTY-SECOND ANNUAL MEETING OF THE

American Public Health Association

MONTREAL, CANADA, SEPTEMBER 25–28

1894

TOGETHER WITH OTHER PAPERS AND AN ABSTRACT OF THE
RECORDS AND PROCEEDINGS

QUARTERLY SERIES, VOLUME I

CONCORD, N. H.
Republican Press Association
1895

NOTE BY THE SECRETARY.

The advantage of publishing the papers and reports presented at the annual meetings in the form of a quarterly journal, as has been during the present year, is self-evident. The reasons for changing from an annual volume to a quarterly, as set forth by the secretary in a paper at the Montreal meeting, and which are embodied in the INTRODUCTION (page 2), have been fully verified. The JOURNAL OF THE AMERICAN PUBLIC HEALTH ASSOCIATION has been most cordially received and endorsed by members of the Association and by the press.

In this volume will be found nearly all the papers and reports presented at the Montreal meeting, together with the important and valuable papers and discussions of the Convention of Bacteriologists, held in New York, 1895, under the auspices of the Committee on the Pollution of Water Supplies. It also contains, as an addenda, the constitution of the Association, by-laws of the executive committee, list of persons elected at the Montreal meeting, officers and committees of the Association, and a list of the sanitary authorities of the United States, Canada, and Mexico.

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CONSTITUTION

OF THE

AMERICAN PUBLIC HEALTH ASSOCIATION.

TITLE.

I. This Association shall be called "THE AMERICAN PUBLIC HEALTH ASSOCIATION."

OBJECTS.

II. The objects of this Association shall be the advancement of sanitary science, and the promotion of organizations and the measures for the practical application of public hygiene.

MEMBERS.

III. The members of this Association shall be known as Active and Associate. The Executive Committee shall determine for which class a candidate shall be proposed. The *Active* members shall constitute the permanent body of the Association, subject to the provisions of the constitution as to continuance in membership. They shall be selected with special reference to their acknowledged interest in or devotion to sanitary studies and allied science, and to the practical application of the same. The *Associate* members shall be elected with special reference to their general interest only in sanitary science, and shall have all the privileges and publications of the Association, but shall not be entitled to vote.

Delegates from national, state, provincial, and municipal boards of health, organized sanitary associations, and the army, navy, and marine hospital service, shall be entitled to be enrolled as active members upon presentation of their credentials to the Executive Committee. Members, not delegates from such bodies, shall be elected as follows:

Each candidate for admission shall first be proposed to the Executive Committee, in writing (which may be done at any time), with a statement of the business or profession and special qualifications of the person so proposed. On recommendation of a majority of the committee, and on receiving a vote of two thirds of the members present at the regular meeting, the candidate shall be declared duly elected a member of the Association. The annual fee of membership in either class shall be five dollars.

OFFICERS.

IV. The officers shall be a President, a First, and a Second Vice-President, a Secretary, and a Treasurer.

All the officers shall be elected by ballot, annually, except the Secretary, who shall be elected for a term of three years.

PRESIDING OFFICER.

V. The President, or in his absence one of the Vice-Presidents, or in their absence a chairman *pro tempore*, shall preside at all meetings of the Association. He shall preserve order, and shall decide all questions of order, subject to appeal to the Association. He shall also appoint all committees authorized by the Association, unless otherwise specially ordered.

SECRETARY.

VI. The Secretary shall have charge of the correspondence and records of the Association; and he shall also perform the duties of Librarian. He, together with the presiding officer, shall certify all acts of the Association. He shall, under the direction of the Executive Committee, give due notice of the time and place of all meetings of the Association, and attend the same. He shall keep fair and accurate records of all the proceedings and orders of the Association; and shall give notice to the several officers, and to the Executive and other committees of all votes, orders, resolves, and proceedings of the Association, affecting them or appertaining to their respective duties.

TREASURER.

VII. The Treasurer shall collect and take charge of the funds and securities of the Association. Out of these funds he shall pay such sums only as may be ordered by the Association, or by the Executive Committee. He shall keep a true account of his receipts and payments, and at each annual meeting render the same to the Association, when a committee shall be appointed to audit his accounts. If, from the annual report of the Treasurer, there shall appear to be a balance against the treasury, no appropriation of money shall be made for any object but the necessary current expenses of the Association, until such balance shall be paid.

STANDING COMMITTEES.

VIII. There shall be the following standing committees: (1) The Executive Committee, (2) the Advisory Council, (3) the Committee on Publication.

EXECUTIVE COMMITTEE.

IX. The Executive Committee shall consist (1) of the President, First Vice-President, Second Vice-President, Secretary, and Treasurer; (2) of six

active members, of whom three shall be elected annually by ballot, to serve two years, and who shall be ineligible to reëlection for a second successive term; and (3) of the ex-Presidents of the Association.

It shall be the duty of the Executive Committee to consider and recommend plans for promoting the objects of the Association, to authorize the disbursement and expenditure of unappropriated moneys in the treasury for the payment of current expenses; to consider all applications for membership, and, at the regular meetings, report the names of such candidates as a majority shall approve; and, generally, to superintend the interests of the Association and execute all such duties as may, from time to time, be committed to them by the Association. At least one month preceding the annual meeting of the Association, the Executive Committee shall cause to be issued to members a notice of such meeting, and they are authorized to publish the same in medical, scientific, and other periodicals, but without expense to the Association; and such notice shall contain the order of business to be followed at said meeting, and, briefly, the subjects to be presented and the special points of discussion.

ADVISORY COUNCIL.

X. The Advisory Council shall consist of one member from each state, territory, and district, the army, navy, and marine hospital service, the Dominion of Canada, and each of the Provinces, who shall be appointed by the President on the last day of each session, and who, besides acting as nominating committee of officers for the ensuing year, to be announced at such time as the Executive Committee may appoint, shall consider such questions and make such recommendations to the Association as shall best secure the objects of the Association. They shall at their first meeting elect from their own number a Secretary, whose record of their proceedings shall be made part of the records of the Association.

COMMITTEE ON PUBLICATION.

XI. The Committee on Publication shall consist of the Secretary and two active members, selected by the Executive Committee, who shall contract for, arrange, and publish, under authority of the Executive Committee, the proceedings of the Association, including such papers as have been examined and approved by the Executive Committee, or which have been submitted to them by the latter for their discretionary action.

REPORTS AND PAPERS.

XII. All committees, and all members preparing scientific reports of papers to be laid before the Association at its annual meetings, must give, in

writing, the title of such reports or papers, the time to be occupied in reading them, and an abstract of their contents, to the Executive Committee, at least one week preceding the date of such meeting, to secure their announcement in the order of business.

MEETINGS.

XIII. The time and place of each annual meeting shall be fixed at the preceding annual meeting, but may be changed by the Executive Committee for reasons that shall be specified in the announcement of the meeting. Special meetings may be called, at any time or place, by concurrence of two thirds of the Executive Committee. There shall be no election of officers, or change of By-Laws, or appropriation of money to exceed the amount at that time in the treasury, at such special meeting, except by a vote of a majority of all the members of the Association. Whenever a special meeting is to be held, at least one month's notice shall, if possible, be given by circular to all the members, together with the order of business.

QUORUM.

XIV. At the annual meeting nine members shall constitute a quorum for the election of officers, a change of the constitution, the election of members, and the appropriation of moneys.

ORDER OF BUSINESS.

XV. The order of business at all meetings of the Association shall be fixed by the Executive Committee, and such order must be completed before any other business is introduced, except such order of business is suspended by a vote of four fifths present.

ALTERATION OF CONSTITUTION.

XVI. No alteration in the Constitution of the Association shall be made except at an annual meeting, or unless such alteration shall have been proposed at a previous meeting, and entered on the minutes with the name of the member proposing the same, and shall be adopted by a vote of two thirds of the members present.

BY-LAWS OF THE EXECUTIVE COMMITTEE.

QUORUM.

1. Five members shall constitute a quorum for the transaction of such business as may come before the committee.

MEMBERS RESTRICTED.

2. No elective member of the Executive Committee shall be at the same time a member of the Advisory Council, if there is another member of the Association from his state or service.

PARLIAMENTARY USAGE.

3. Cushing's Law and Practice of Legislative Assemblies shall be the guide of parliamentary practice until otherwise ordered.

PAPERS.

4. All papers presented to the Association must be either printed, type written, or in plain handwriting, and be in the hands of the Secretary at least twenty days prior to the annual meeting, to insure their critical examination as to their fulfilling the requirements of the Association.

5. If any paper is too late for critical examination, said paper may be so far passed upon by the Executive Committee as to allow its reading, but such paper shall be subject to publication or non-publication, as the Executive Committee deem expedient.

6. All papers accepted by the Association, whether read in full, by abstract, by title, or filed, shall be delivered to the Secretary as soon as thus disposed of, as the exclusive property of the Association. Any paper presented to this Association and accepted by it shall be refused publication in the transactions of the Association, if it be published, in whole or in part, by permission or assent of its author, in any manner prior to the publication of the volume of transactions, unless written consent is obtained from the Publication Committee.

7. All papers on subjects within the province of special committees shall be referred to the chairmen of the several committees, who shall report the same to the Association incorporated with their annual reports, or refer them to the Executive Committee for consideration.

8. No paper shall hereafter be considered, of which a condensed abstract shall not have been placed in the hands of the secretary at least twenty days before the date of the annual meeting.

9. Chairmen of committees, in making reports, shall be absolutely limited to thirty minutes, reading of papers to twenty minutes, and participants in discussion to five minutes.

10. Papers presented to the Association shall be confined to strictly sanitary, climatologic, and preventive questions, all clinical, pathological, therapeutic, or other strictly medical statements being excluded; nor shall any paper tending to the advertisement of special or local interests or establishments be accepted.

11. The Secretary shall have no discretion in the matter of the enforcement of the regulations of the Executive Committee as to the acceptance of papers.

PUBLICATION COMMITTEE.

12. The Committee on Publication, charged with the duties of selecting and printing the papers and transactions of the Association, shall consist of three active members of the Association, and of whom one shall be the Secretary, appointed by the Executive Committee during the session of the Association, and selected with reference to their facilities of meeting.

13. All papers read by title, and others not definitely passed upon by the Executive Committee, shall be referred to the Publication Committee for critical examination; and said committee is authorized to reject such papers as in its judgment are not worthy of publication, and to omit such others as cannot be included within the limits of the annual volume.

14. The Publication Committee shall procure a copyright on the transactions in the name of the Association, and the committee shall have full charge of the publication of the transactions.

APPLICATION FOR MEMBERSHIP.

15. All applications for membership must be made upon the application blank of the Association.

16. Persons not members, having prepared papers to be presented at the meetings of the Association, shall be proposed for membership at the first business meeting of the Association.

EXPENDITURES.

17. All bills connected with the publication of the transactions shall, upon the approval of the chairman of the Publication Committee and the Secretary, be signed by the President of the Association, and paid by check of the Treasurer directly to the party concerned; and the President shall not

approve any bill, relating either to publishing or printing, without the approval first of the chairman of the committee in charge thereof.

18. Bills for current expenses shall be first approved by the Secretary, then sent to the President, and on his approval they shall be paid by check of the Treasurer directly to the parties interested.

19. The actual and necessary travelling expenses of the Secretary and Treasurer to the annual meeting of the Association, and to one meeting of the Executive Committee, shall be classed as current expenses.

RESOLUTIONS.

20. All resolutions presented to the Association shall be sent to the Chair in writing, and referred to a committee without discussion.

ARREARAGES.

21. The arrearages of all members remitting their dues for two years shall be cancelled up to the date of the last payment, but they shall be entitled to the transactions of the Association only for the years for which they have actually paid.

AUDITING COMMITTEE.

22. An Auditing Committee shall be appointed by the Chair to audit the accounts of the Treasurer, and report upon the same.

OFFICERS AND COMMITTEES

OF THE

AMERICAN PUBLIC HEALTH ASSOCIATION.

OFFICERS, 1894–1895.

President, ...	Dr. WILLIAM BAILEY, *Louisville, Ky.*
First Vice-President, .	Dr. GRANVILLE P. CONN, *Concord, N. H.*
Second Vice-President,	Dr. GREGORIO MENDIZABAL, *Orizaba, Vera Cruz, Mexico.*
Secretary, ...	Dr. IRVING A. WATSON, *Concord, N. H.*
Treasurer, ...	Dr. HENRY D. HOLTON, *Brattleboro', Vermont.*

EX-PRESIDENTS OF THE ASSOCIATION.

Prof. STEPHEN SMITH	*New York City.*
Dr. JOSEPH M. TONER	*Washington, D. C.*
Deputy Surgeon General JOHN S. BILLINGS	*U. S. Army.*
Prof. ROBERT C. KEDZIE	*Lansing, Mich.*
Medical Director ALBERT L. GIHON	*U. S. Navy.*
Dr. JAMES E. REEVES	*Chattanooga, Tenn.*
Dr. HENRY P. WALCOTT	*Cambridge, Mass.*
Surgeon General GEORGE M. STERNBERG	*U. S. Army.*
Dr. CHARLES N. HEWITT	*Red Wing, Minn.*
Dr. HENRY B. BAKER	*Lansing, Mich.*
Dr. FREDERICK MONTIZAMBERT	*Quebec, Canada.*
Dr. FELIX FORMENTO	*New Orleans, La.*
Dr. SAMUEL H. DURGIN	*Boston, Mass.*
Dr. E. P. LACHAPELLE	*Montreal, P. Q.*

(The ex-Presidents, *ex-officio* members Executive Committee.)

STANDING COMMITTEES.

EXECUTIVE COMMITTEE.

(Elective.)

Dr. JAMES T. REEVE	*Appleton, Wis.*
Dr. EDUARDO LICÉAGA	*Mexico, Mex.*
Dr. PINCKNEY THOMPSON	*Henderson, Ky.*
Dr. HENRY I. BAHNSON	*Salem, N. C.*
Dr. PETER H. BRYCE	*Toronto, Ont.*
Dr. E. P. DEVAUX	*Valley City, N. D.*

ADVISORY COUNCIL.

UNITED STATES:

Alabama	Dr. JEROME COCHRAN, *Mobile.*
Arkansas	Dr. H. C. DUNNAVANT, *Osceola.*
California	Dr. WM. FREDERIC WIARD, *Sacramento.*
Colorado	Dr. HENRY SEWELL, *Denver.*
Connecticut	Dr. R. S. GOODWIN, *Thomaston.*
Delaware	Mr. W. C. R. COLQUHOUN, *Wilmington.*
Florida	Dr. JOSEPH Y. PORTER, *Key West.*
Georgia	Dr. WILLIAM F. BRUNNER, *Savannah.*
Illinois	Dr. A. R. REYNOLDS, *Chicago.*
Indiana	Dr. LINDSAY S. WHITESIDES, *Franklin.*
Iowa	Dr. A. W. CANTWELL, *Davenport.*
Kansas	Dr. DANIEL C. JONES, *Topeka.*
Kentucky	Dr. J. N. McCORMACK, *Bowling Green.*
Louisiana	Dr. FELIX FORMENTO, *New Orleans.*
Maine	Dr. A. G. YOUNG, *Augusta.*
Maryland	Dr. JAMES F. McSHANE, *Baltimore.*
Massachusetts	Dr. SAMUEL W. ABBOTT, *Wakefield.*
Michigan	Dr. CRESSY L. WILBUR, *Lansing.*
Minnesota	Dr. E. S. KELLEY, *Minneapolis.*
Mississippi	Dr. WIRT JOHNSTON, *Jackson.*
Missouri	Dr. J. D. GRIFFITH, *Kansas City.*
Nebraska	Dr. FREDERICK D. HALDEMAN, *Ord.*
New Hampshire . . .	Dr. CHARLES R. WALKER, *Concord.*
New Jersey	Dr. HENRY MITCHELL, *Asbury Park.*
New Mexico	Dr. FRIEND PALMER, *Cerrillos.*
New York	Dr. A. NELSON BELL, *Brooklyn.*
North Carolina . . .	Dr. HENRY I. BAHNSON, *Salem.*
North Dakota	Dr. O. WELLINGTON ARCHIBALD, *Jamestown.*
Ohio	Dr. C. O. PROBST, *Columbus.*
Oklahoma Ter	Dr. CHARLES F. WALDRON, *Oklahoma City.*
Pennsylvania	Dr. BENJAMIN LEE, *Philadelphia.*
Rhode Island	Dr. GARDNER T. SWARTS, *Providence.*
South Carolina	Dr. H. B. HORLBECK, *Charleston.*
South Dakota	Dr. K. M. O. TEIGEN, *Fargo.*
Tennessee.	Dr. J. BERRIEN LINDSLEY, *Nashville.*
Texas	Dr. R. M. SWEARINGEN, *Austin.*
Vermont	Dr. CHARLES S. CAVERLY, *Rutland.*
Virginia	PROF. JOHN B. MINOR, *University of Virginia.*
Washington	Dr. G. S. ARMSTRONG, *Olympia.*
West Virginia	Dr. LOUIS D. WILSON, *Wheeling.*
Wisconsin	Dr. U. O. B. WINGATE, *Milwaukee.*
Dist. of Columbia . .	Dr. RALPH WALSH, *Washington.*
U. S. Army	Dep. Surg. Gen. A. H. WOODHULL, *Denver, Colo.*
U. R. M. H. Service . .	Surgeon P.H.BAILHACHE, *Stapleton,Staten Island,N.Y.*

CANADA:

Dominion of Canada .	Dr. FREDERICK MONTIZAMBERT, *Quebec.*
Province of Ontario .	Dr. PETER H. BRYCE, *Toronto.*
Province of Quebec . .	Mr. HENRY R. GRAY, *Montreal.*
Manitoba	Dr. JAMES PATTERSON, *Winnipeg.*
New Brunswick . . .	Dr. GEORGE E. COULTHARD, *Fredericton.*
Nova Scotia	Dr. A. P. REID, *Halifax.*

MEXICO:

Aguascalientes . . .	Dr. AGUSTIN CHACON, *Mexico.*
Campeche	Dr. JOSE T. FERRER, *Mexico, Mex.*
Colima	Dr. EUGÉNIO Z. GOMEZ, *Colima.*
Coahuila	Dr. DIONISIO GARCIA FUENTES, *Saltillo.*
Chihuahua	Dr. MIGUEL MARQUES, *Chihuahua.*
Chiapas	Dr. FRANCISCO MARIN, *Pueblo.*
Durango	Dr. FERNANDO ZARRAGA, *Mexico, Mex.*
Guanajuato	Dr. JESUS CHICO, *Guanajuato.*
Guerrero	Dr. DOMINGO ORVAÑANOS, *Mexico, Mex.*
Hidalgo	Dr. LUIS RUIZ, *Mexico.*
Jalisco	Dr. JUAN J. RAMIREZ DE ARELLANO, *Mexico, Mex.*
Michoacán	Dr. ROQUE MACOUZET, *Mexico, Mex.*
Morelos	Dr. ANGEL GAVIÑO, *Mexico, Mex.*
México	Dr. ALBERTO ESPINOSA, *Pachuca.*
Nuevo León	Dr. THOMAS NORIEGA, *Mexico, Mex.*
Oaxaca	Dr. DEMETRIO MEXIA, *Mexico, Mex.*
Puebla	Dr. ANGEL CONTRERAS, *Puebla.*
Querétaro	Dr. MANUEL SEPTIEN, *Querétaro.*
San Luis Potosí . . .	Dr. JESUS MONJARAS, *San Luis Potosí.*
Senora	Dr. ALBERTO NORIEGA, *Hermosillo.*
Sinaloa	Dr. RAMON ICAZA, *Mexico, Mex.*
Tabasco	Dr. EDUARDO GARCIA, *Mexico, Mex.*
Tamaulipas	Dr. T. MARTINEZ CALLEJA, *C. Victoria.*
Tlaxcala	Dr. JOSE TERRES, *Mexico, Mex.*
Vera Cruz	Dr. GREGORIO MENDIZABAL, *Orizaba.*
Yucatan	Dr. JOSE PEON CONTRERAS, *Mexico.*
Zacatecas	Dr. WASHINGTON MALLET PREVOST, *Mexico, Mex.*
Territorio de le BajaCalif[a]	Dr. FEDERICO COTA, *La Paz.*
Territorio de Tepic . .	Dr. JUAN H. REVUELTAS, *Tepic.*
Distrito Federal . . .	Dr. NICOLAS RAMIREZ DE ARELLAUS, *Mexico, Mex.*

SPECIAL COMMITTEES.

PUBLICATION COMMITTEE.

Dr. IRVING A. WATSON	Concord, N. H.
Dr. GRANVILLE P. CONN	Concord, N. H.
Dr. SAMUEL W. ABBOTT	Wakefield, Mass.

ON THE POLLUTION OF WATER-SUPPLIES.

Major CHARLES SMART, U. S. A. . . . . Washington, D. C.
(With authority to select associates).

ON THE DISPOSAL OF GARBAGE AND REFUSE.

RUDOLPH HERING, C. E.	277 Pearl St., New York City.
Prof. DELOS FALL	Albion, Mich.
Dr. LOUIS LABERGE	Montreal, P. Q.
Dr. HENRY F. HOYT	St. Paul, Minn.
ROBERTO GAYOL, C. E.	Mexico, Mex.

ON ANIMAL DISEASES AND ANIMAL FOOD.

D. E. SALMON, D. V. M.	Washington, D. C.
Prof. JAMES LAW	Ithaca, N. Y.

Prof. José L. Gomez	Mexico, Mex.
Dr. Pinckney Thompson	Henderson, Ky.

ON NOMENCLATURE OF DISEASES AND FORMS OF STATISTICS.

Dr. Samuel W. Abbott	Wakefield, Mass.
Dr. Jesus E. Monjaras	San Luis Potosi, Mex.
Dr. Elzéar Pelletier	Montreal, P. Q.
Prof. Charles A. Lindsley	New Haven, Conn.
Dr. Charles N. Hewitt	Red Wing, Minn.

ON PROTECTIVE INOCULATIONS IN INFECTIOUS DISEASES.

Prof. Victor C. Vaughan	Ann Arbor, Mich.
Surgeon-General George M. Sternberg, U. S. A.	Washington, D. C.
Dr. George H. F. Nuttall	Baltimore, Md.
Dr. M. Carmona y Valle	Mexico, Mex.
Dr. J. E. Laberge	Montreal, P. Q.

ON NATIONAL HEALTH LEGISLATION.

Dr. Henry P. Walcott	Cambridge, Mass.
Dr. J. N. McCormack	Bowling Green, Ky.
Dr. Irving A. Watson	Concord, N. H.
Dr. James D. Plunket	Nashville, Tenn.
Dr. Henry B. Baker	Lansing, Mich.
Dr. Samuel R. Oliphant	New Orleans, La.
Dr. Richard M. Swearingen	Austin, Tex.
Dr. Henry B. Horlbeck	Charleston, S. C.
Dr. Benjamin Lee	Philadelphia, Pa.
Dr. Samuel H. Durgin	Boston, Mass.
Dr. U. O. B. Wingate	Milwaukee, Wis.
Dr. Stephen Smith	New York.
Dr. C. O. Probst	Columbus, O.

ON THE CAUSE AND PREVENTION OF DIPHTHERIA.

Dr. George C. Ashmun	Cleveland, O.
Dr. Peter H. Bryce	Toronto, Ont.
Dr. Juan Ramirez de Arellano	Mexico, Mex.
Dr. Wyatt Johnston	Montreal, P. Q.
Dr. A. W. Suiter	Herkimer, N. Y.

ON CAUSES AND PREVENTION OF INFANT MORTALITY.

Dr. Charles N. Hewitt	Red Wing, Minn.

(With authority to select associates.)

ON RESTRICTION AND PREVENTION OF TUBERCULOSIS.

Dr. J. N. McCormack	Bowling Green, Ky.
Dr. H. B. Baker	Lansing, Mich.
Dr. P. H. Bryce	Toronto, Ont.
Dr. Henry Sewall	Denver, Col.
Dr. U. O. B. Wingate	Milwaukee, Wis.

ON CAR SANITATION.

Dr. Granville P. Conn	Concord, N. H.
E. C. Jordon, C. E.	Portland, Me.
Dr. Domingo Orvañanos	Mexico, Mex.
Dr. William Oldright	Toronto, Ont.
Dr. E. R. Lewis	Kansas City, Mo.

INTERNATIONAL COMMITTEE ON THE PREVENTION OF THE SPREAD OF YELLOW FEVER.

Dr. Felix Formento	New Orleans, La.
Surgeon-General George M. Sternberg, U. S. A.	Washington, D. C.
Dr. Eduardo Licéaga	Mexico, Mex.
Dr. Manual Carmona y Valle	Mexico, Mex.
Dr. Jerome Cochran	Mobile, Ala.
Dr. Samuel R. Oliphant	New Orleans, La.
Mr. Alfred V. Wood	Brunswick, Ga.

ON STEAMSHIP AND STEAMBOAT SANITATION.

Dr. Farquhar Ferguson	New York City
Dr. Frederick Montizambert	Quebec, Canada.
Dr. Samuel R. Oliphant	New Orleans, La.
Dr. H. B. Horlbeck	Charleston, S. C.
Dr. Albert L. Gihon, U. S. N.	Washington, D. C.

ON THE TRANSPORTATION OF THE DEAD.

Dr. Jefferson D. Griffith	Kansas City, Mo.
Dr. Peter H. Bryce	Toronto, Ont.
Dr. Charles D. Smith	Portland, Me.

ON DISPOSAL OF THE DEAD.

Dr. C. O. Probst	Columbus, O.
Dr. Farquhar Ferguson	New York City.
Mr. George W. Fuller	Lawrence, Mass.
Dr. Elzéar Pelletier	Montreal, P. Q.
Dr. Jesus Chico	Guanajuato, Mex.

ON THE USE OF ALCOHOLIC DRINKS FROM A SANITARY STANDPOINT.

Dr. Felix Formento	New Orleans, La.
Dr. C. O. Probst	Columbus, O.
Dr. E. P. Lachapelle	Montreal, P. Q.

CHAIRMAN LOCAL COMMITTEE OF ARRANGEMENTS.

Dr. Henry Sewall	Denver, Col.

MEMBERS ELECTED AT THE MONTREAL MEETING, 1894.

Dr. HERMAN JACOBY ACHARD . . . . Manchester, N. H.
Dr. CHARLES EVERETT ADAMS, Director of Gymnasium, Rogers' College . . . . New Brunswick, N. J.
Dr. E. HERBERT ADAMS, Member of Committee on Public Health, Ontario Medical Association, 86 Hazelton Ave., Toronto, Ont.
Dr. J. GEORGE ADAMI, Professor of Pathology McGill University . . . . Montreal P. Q.
JOHN G. ADAMS, L. D. S. . . . . . . 346 Young St., Toronto, Ont.
Dr. T. JOHNSON ALLOWAY, Professor of Gynæcology, McGill University . . . . . . 23 Mackay St., Montreal, P. Q.
Mr. U. E. ARCHAMBAULT, Director General of Montreal Catholic Schools . . . . 1999 St. Catharine St., Montreal, P. Q.
Dr. JOSEPH ASSELIN . . . . 111 St. Denis St., Montreal, P. Q.
Mr. JOHN ATKIN . . . . 158 Metcalfe St., Montreal, P. Q.
Dr. ALPHONSE DAVID AUBRY . . . . 261 St. Antoine St., Montreal, P. Q.
Dr. CHARLES EDWARD BANKS, U. S. Marine Hospital Service . . . . Portland, Me.
Dr. GEORGE E. BARIL, ... 324 St. Catharine St., Montreal, P. Q.
Dr. FELIX BARRETT . . . . Westbrook, Me.
Dr. EDWARD P. BARTLETT, Secretary Illinois Army and Navy Medical Association . . . . 514 Capital Ave., Sangmon, Ill.
Dr. JOSEPH BEAUDIN, Officier de Sante . . . . . Hull, P. Q.
F. L. BEIQUE, Esq., Queen's Counsel . . 954 Sherbrooke St., Montreal, P. Q.
Dr. JAMES BELL, President Montreal Medico-Chirurgical Society . . . . 873 Dorchester St., Montreal, P. Q.
Dr. EMMANUEL PERSILLIER BENOIT . . 476 Sherbrooke St., Montreal, P. Q.
Dr. DAVID H. BERGEY . . . . 34th and Locusts Sts., Philadelphia, Pa.
Mr. L. A. BERNARD . . . . . 1882 St. Catharine St., Montreal, P. Q.
Dr. H. A. BIRKETT, Lecturer in Laryngology, McGill University . . . . 123 Stanley St., Montreal, P. Q.
Dr. A. D. BLACKADER, Professor of Pharmacology and Therapeutics, McGill University . 236 Mountain St., Montreal, P. Q.
ALEXANDRE BONNIN, I. C. Professor á l'Ecole Polytechnique . . . . 247 St. Hubert St., Montreal, P. Q.
Dr. SERAPHIN BOUCHER . . . . . . 1133 Ontario St., Montreal P. Q.
Dr. CHARLES W. BRAY . . . . Portland, Me.
Dr. T. M. BRENNAN, Professor Laval University . . Montreal, P. Q.
Dr. AZARIE BRODEUR . . . . . . 707 Sherbrooke St., Montreal, P. Q.
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(This state formerly had a state board of health, but has allowed it to become extinct, from lack of appropriations.)

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(Has no state board of health. Provision is made for the appointment of health officers by the various boards of county commissioners; but they are answerable to the local authorities only.)

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(Has no state board of health.)

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JOURNAL

OF THE

American Public Health Association.

ANNUAL VOLUME, NO. XX. | JANUARY, 1895. | QUARTERLY SERIES, VOL. I, PART I.

INTRODUCTION.

By the SECRETARY.

The American Public Health Association has decided to issue a quarterly journal in place of the annual volume of Transactions. At the Montreal meeting of the Association, September 25–28, 1894, the Secretary read a brief paper entitled, "A Journal of the American Public Health Association," setting forth some of the advantages of publishing a quarterly journal.

Upon the completion of the reading of the paper, the Association voted unanimously to refer the matter to the Advisory Council for such action as that body might deem best.

At a meeting of the Advisory Council, held Sept. 27, the matter was taken up and the following resolution adopted:

Resolved, That the question of publishing the transactions of the Association quarterly be referred to the Executive Committee to arrange for such publication if the scheme be found practicable.

At a meeting of the Executive Committee, held Sept. 28, the question of publishing a quarterly journal was discussed in detail, and, as the plan seemed to be not only practicable but advisable, the following resolution was unanimously adopted:

Resolved, That the Publication Committee be directed to issue the transactions of the Association in quarterly parts, on the first of January, first of April, first of July, and the first of October annually.

Discretionary power was also given the Publication Committee to make such additions in the matter of new papers, editorial notes, etc., as they deem advisable.

We desire to say to those who have long been members of this Association and who are proud of the nineteen magnificent volumes of the Transactions, that in changing to a quarterly journal we shall keep in

view the continuation of these volumes in uniform size and binding. Arrangements will be made so that each member, if he desires, can have the Quarterly bound at the end of the year, uniformly with the preceding Transactions without other expense than that of returning in good condition the quarterly parts. The Transactions of this Association constitute in themselves almost a library on sanitation, and it is proposed to continue this splendid series without further alteration than that indicated above.

Some of the advantages of the Quarterly were stated by the Secretary in presenting the matter to the Association, as follows:

I. It is in the line of progress. In a Quarterly, issued in January, April, July, and October, the members would receive the papers and reports of the Association at stated intervals instead of one volume nearly a year after the annual meeting, which work is too often put upon the library shelf for reference instead of receiving that perusal which is accorded a magazine.

2. It would be cheaper than the annual volume, or, to put it differently, a much larger edition could be printed, if issued quarterly, with the same money, or less, than is now being expended.

3. The circulation might be increased by subscriptions from health officers and others directly and practically interested in sanitary work.

4. A journal would increase the strength and influence of this Association by making its objects better known, and by placing its work before the public four times a year in an attractive form instead of issuing one bound volume a year. As a Quarterly it could be sent in exchange to the leading sanitary and medical journals, through which the Association would receive the recognition that its work merits. A journal would not only be the means of extending the influence of the Association and of more widely promulgating sanitary science, but would enhance its reputation and ensure for it an increased power in the sanitary world.

The marvelous growth of this Association in a few years from a little, conference group of sanitarians to the largest public health association in the world, embracing as it does three great countries—the United States of America, the Dominion of Canada, and the Republic of Mexico,—merits, perhaps, at this time a brief historical notice.

By previous arrangement, a few gentlemen interested in the study of sanitary science, met at the New York Hotel, New York city, on Friday evening, April 18, 1872, for the purpose of "creating a permanent association for promoting public health interests." This group consisted of Drs. Stephen Smith, Elisha Harris, E. H. Janes, Heber Smith, Moreau Morris, and Carl Pfeiffer, Esq., of New York city; Dr. Francis Bacon of New Haven, Conn.; Dr. Christopher Cox of Washington, D. C.; and Dr. John H. Rauch of Chicago, Ill. At this meeting it was voted to form a permanent organization, and several additional gentlemen were elected members.

The second meeting was held at the Ocean Hotel, Long Branch, N. J., Sept. 12, 1872. The records show that twelve persons were present. A proposed plan of organization was presented, which was revised and adopted as the "constitution of the American Public Health Association." At this session seventy persons, nearly all of whom were physicians interested in sanitary work, were elected to membership. A long list of committees on various sanitary topics were appointed, and after the organization was perfected in detail the meeting adjourned.

The next meeting, (which was announced as the annual meeting), was held at Cincinnati, Ohio, May 1–3, 1873. The records show that seventeen persons were present. The session was an active one, several papers were read and resolutions relating to public health topics adopted.

The next annual meeting was held in New York city on Nov. 11-14, 1873.

On the first day of this session several papers were read. The record of the second day's proceedings contains the following:

"A roll of members being called, it was found that the constitutional quorum of 25 was not present, and the same difficulty having occurred at all of the previous meetings since the organization of the Association, on motion of Dr. Woodward, U. S. A., the Association was dissolved and adjourned *sine die*. It was then

"*Resolved*, That the members present of the late Association proceed to form an organization to be called the 'American Public Health Association.'"

The original constitution was amended in several particulars, chief of which was to make nine members a quorum for the transaction of business. It was also voted that the Association "assume all pecuniary liabilities of the late American Public Health Association."

This record shows that the American Public Health Association as it now exists was legally organized on the 12th day of November, 1873, although it was in fact created on the evening of April 18, 1872.

The following is a list of the meetings of the Association to the present time:

Preliminary meeting,	New York, N. Y.,	April 18, 1872.
" "	Long Branch, N. J.,	September 12, 1872.
"Annual meeting,"	Cincinnati, Ohio,	May 1–3, 1873.
1st Annual meeting,	New York, N. Y.,	November 11–14, 1873.
2d " "	Philadelphia, Pa.,	November 10–13, 1874.
3d " "	Baltimore, Md.,	November 9–12, 1875.
4th " "	Boston, Mass.,	October 3–6, 1876.
5th " "	Chicago, Ill.,	September 25–27, 1877.
6th " "	Richmond, Va.,	November 19–22, 1878.
7th " "	Nashville, Tenn.	November 18–21, 1879.
8th " "	New Orleans, La.,	December 7–10, 1880.
9th " "	Savannah, Ga.,	November 29–Dec. 2, 1881.
10th " "	Indianapolis, Ind.,	October 17–20, 1882.
11th " "	Detroit, Mich.,	November 13–15, 1883.
12th " "	St. Louis, Mo.,	October 14–17, 1884.

13th	Annual Meeting,	Washington, D. C.,	December 8–11, 1885.
14th	" "	Toronto, Canada,	October 5–8, 1886.
15th	" "	Memphis, Tenn.,	November 8–11, 1887.
16th	" "	Milwaukee, Wis.,	November 20–23, 1888.
17th	" "	Brooklyn, N. Y.,	October 22–25, 1889.
18th	" "	Charleston, S. C.,	December 16–19, 1890.
19th	" "	Kansas City, Mo.,	October 20–23, 1891.
20th	" "	Mexico, Mex.,	November 29–Dec. 2, 1892.
21st	" "	Chicago, Ill.,	October 9–14, 1893.
22d	" "	Montreal, Canada,	September 25–28, 1894.

In a few years the Association had become so strong and influential that a proposition was made at the St. Louis meeting in 1884 to include Canada within the territorial area of the Association, and a change in the constitution to accomplish this was proposed, which change was adopted at the Washington meeting in 1885, giving representation to the Dominion of Canada and the several Provinces in the Association.

Subsequently it was proposed to interest the Republic of Mexico in the work of the Association, and to that end in 1890 the Secretary officially invited the government of Mexico and the National Board of Health of that country to send delegates to the Charleston meeting. This invitation was accepted, and two delegates from Mexico were present.

The next year, at the Kansas City meeting, (1891), a proposition to amend the constitution so as to admit Mexico and the several Mexican states was presented, which change was made at the meeting in the City of Mexico in 1892.

It will be seen from the foregoing brief history that the Association has grown in 22 years from a little parlor organization to the largest public health association in the world, embracing in territorial area three great countries, nearly the entire North America.

The Association has issued nineteen large and valuable volumes, embracing the reports, papers, and discussions of its annual meetings. In addition, it has published in a separate volume the work of one of its committees on "Disinfection and Disinfectants," which embraces a large amount of original research, and which at once assumed a standard place in the literature of the subject. Further, it has published the Lomb Prize Essays, over 100,000 copies of which have been distributed in this country. Many of its papers and reports have been widely circulated in pamphlet form.

The record of the Association from its beginning to the present time has been one of continual progress, and its influence in sanitary legislation and public health work generally, cannot be over-estimated. The Association was never so strong as at the present time, and the high character of the organization makes it an honor to any person to be a member of it. We trust this new departure in its publication will prove to be another onward step in the advancing course of the American Public Health Association.

THE PRESIDENT'S ADDRESS.[1]

By E. PERSILLER-LACHAPELLE, M. D., of Montreal, Canada.

Your Excellency,[2] Your Honor,[3] Mr. Chairman—Ladies and Gentlemen: It is not without a legitimate feeling of uneasiness that I rise on this important occasion, to address you in a tongue that is somewhat strange to me. I avow that the dictates of duty would scarcely be powerful enough to develop sufficient courage, were I not assured, previously, of your benevolence and lenity. Encouraged by this reliance on your indulgence, I shall proceed, and, by being as short as possible, I hope to merit your good-will.

The American Public Health Association, since its foundation, now twenty-two years ago, ever true to its mission, has never ceased to "labor for the advancement of sanitary science—for the promotion of measures and organizations that should effect the practical accomplishment of the laws and principles of public hygiene." It has thus realized the brightest hopes and most enthusiastic previsions of its worthy founders, and has extended its benefits and influence over the whole of North America; to-day, it embraces the three great countries that form this vast continent: the United States of America, the Republic of Mexico, and the Dominion of Canada, all three working together in brotherly emulation, recognizing no political boundaries, and valiantly striving to attain one unique and humane object: the dissemination to all of the knowledge of public hygiene and the development of respect for its decrees.

It is, therefore, Fellow-members of the Association, with the greatest pleasure—after having taken part in our former meetings in the principal cities of the United States and Mexico, reaped precious knowledge, and borne away happy remembrances—that I see us all, to-day, congregated in this city, the commercial metropolis of our Canada. I know we shall be pleased to again find ourselves united, not only to strengthen the bonds of friendship formed in preceding meetings, but also to communicate to one another the fruits of recently acquired experience and knowledge, each contributing his mite to help the progress of hygiene among our people, and so continue the good work of our Association.

Every year the Association changes its places of meeting, and this for good reasons. The spirit of its founders being to establish, above all, a body for the diffusion and popularization of public sanitary science, this object could not be better attained than by extending to its greatest limits the influence of the Association; and for this purpose, no surer means

[1] Delivered at the formal opening of the twenty-second annual meeting of the American Public Health Association, Montreal, Canada, September 25, 1894.

[2] Honorable J. A. Chapleau, lieutenant-governor of the Province of Quebec.

[3] Mr. J. O. Villeneuve, mayor of Montreal.

could be found than this bringing together of its distinguished members in different, distant cities. There, they are allowed to see and judge for themselves of the wants and progress of the different parts of the continent; their experience is enriched, they compare observations, and suggest new ideas. Again by adopting this method of meeting, the same members are not continually called upon to displace themselves, which would often entail considerable sacrifices.

On the one hand, not only do the members themselves derive considerable profit from such changes, but, on the other hand, and above all, those congresses in various parts of the continent immensely facilitate the propagation of our science to the public, by awakening, as they do, general interest wherever they are held; they help to dissipate erroneous ideas and prejudice by giving publicity to the unbiased opinions of a large number of enlightened and disinterested men on local questions; they are of great assistance to governments by having those important questions solved according to the requirements of each country; they give the authorities strength, confidence, and courage to put into practice much needed measures; they even force them to act. Schools, universities, local boards of health, municipal authorities, and others feel the stimulus thus imparted, and labor on with fresh and invigorating impetus.

Judging, as I do, from what has occurred elsewhere, I feel convinced that Montreal, and this province in general, will reap much benefit from this learned and important congress. Wherever the Association has met, it has stimulated and guided the march of progress, and it is becoming more and more respected and honored by the grateful public, for it ever leaves behind it tangible and irrevocable proofs of the good work it propagates.

Ladies and Gentlemen,—Hygiene is no longer the patrimony of physicians exclusively:— it is a science open to all: laymen and clergymen, men and women. It needs supporters and workers in all classes; engineers, architects, teachers, chemists, etc., etc. In a word, it appeals to all who are competent to aid its progress.

This universality of sanitary science has been productive of the most brilliant results; to it, we owe the greatest part of recent progress. What would hygiene be, to-day, bereft of the admirable discoveries of a layman, the illustrious Pasteur?—that light of modern science who has created such a revolution in our knowledge of the true causes of contagious diseases, and their modes of spreading; who has been the forerunner and inciter of all our modern effective methods of prevention and treatment of those scourges and is the real father of actual antiseptic medicine.

All cannot be Pasteurs, but all can work. Every one should contribute a mite of help or knowledge, thus securing universal interest and co-operation. There should be perfect solidarity as to individuals and nations with regard to public hygiene.

Contagious diseases and epidemics respect no political frontiers; it

therefore requires union and a common interest to effectually put a check to their invasion and extension.

The recognition of this fact relating more directly to adjoining countries, has caused our Association, originally founded in the United States, to gradually extend and naturally embrace the three contiguous countries which form North America and whose sanitary interests are identical. It is for this reason again, that it holds its annual meetings in divers sections of the continent, appealing to and bringing together in one harmonious family all the sanitarians of North America, to submit to their careful study health problems which interest them all.

Herein lies the explanation of the immense progress accomplished on this continent during the last twenty years. Judicious and scientific quarantine has been established in all quarters; state, provincial, and local boards of health have become generalized, and have adopted wise and important sanitary measures and regulations.

Public opinion has been converted, popular prejudice giving way to unwavering confidence. Governments have thus been enabled, without risking their often precarious existence, to cause important decrees of hygiene to be sanctioned by parliaments, and to have the necessary funds voted to permit of their being put into practice. Hygiene having thus drawn their attention, they begin to understand the necessity of strenuous means being employed to assure its advancement, and they realize the fact, that instead of being detrimental to public commercial interests, sanitary measures favor their growth by protecting the country from disease. They recognize, to-day, that the money and labor spent in upholding sanitary principles are repaid manifold by the security afforded to public health, a more continuous and active trade being thus assured.

May we not hope that governments, fully realizing the importance of those questions and wishing to afford greater facilities for protection, will soon see the necessity of creating a new deparment in their cabinets:—that of Public Health: and that in the near future all governments will be advised and supported by a competent specialist—a minister of Public Health? We can easily foresee all the good that will arise from the creation of such a position.

Ladies and Gentlemen,— Although it is encouraging and pleasing to note the progress realized, the success obtained, we must not believe the task is done, and that all obstacles have vanished. For instance, the adoption of measures requisite to put into practice the solution of a question of sanitation, collides with two great and serious obstacles—expenditure and personal interests. Such is the case when measures for quarantine, isolation, disinfection, the cleansing of towns and seaports, the prohibition of adulterated food, etc., are put into force.

Quarantine, so needful to protect against the invasion of exotic epidemic diseases, is no longer, thanks to the progress of hygiene, what it was formerly. Detention is shorter, I may say practically suppressed, by our modern methods of effective disinfection; but, nevertheless, even the

slightest delay in the unloading of a ship begets expense, and brings constraint on personal interests.

I might say the same of the other measures mentioned; each calls for expenditure of money, time, and labor, and is sure to affect the interests of some one. In this way, opposition is brought to bear on the introduction of would-be effectual means of protection, by persons who are really wronged, or believe themselves so. On the other hand, those for whom protection is sought, are mostly indifferent to the labor and worry that is expended for their safety.

It is not surprising, then, that governments and parliaments should often hesitate, and frequently withdraw their support. On one side, they have small reason and light pressure to act; on the other, great influence is thrust forward to make them desist. What is here needed to insure success is the voice of authoritative knowledge and teaching, and congresses of sanitary science, such as this one, composed as they are of eminent and influential men, can alone furnish cogent authority.

To the pretensions of interested individuals who often, in an exaggerated manner, plead expense and trespass on their private affairs, and to the hesitating, faltering governments that listen to those reclamations and are made to doubt the utility, efficacy, even urgency, of the requested measures, we can oppose the authority of decisions rendered on those questions by the most authorized and disinterested sanitarians of various countries; such decisions having been formed in open convention, after serious study and discussion, possess a value and respect which cannot easily be ignored or set aside. We have the hopes, therefore, of seeing governments ignore the opposition of the ones and the apathy of the others to accede to our humane demands.

Such have been the cares and tendencies of our Association since its foundation, and we may state with pride that the results obtained so far, in all directions, are an encouragement to labor on earnestly and vigorously for the achievement of the task that is left to be accomplished. May the success of the future even exceed that of the past.

To fulfil the spirit of our annual meetings, we must then choose questions that require the most immediate decision, study them fully, discuss them attentively, and try to effect a solution of them based on the experience of other countries and on the most recent decrees of modern science. We must bear in mind that ours is a science of application, whose problems may differ according to localities and circumstances; and that, it thus belongs to each state and province to choose questions, and accept solutions most in accordance with local customs, climate, and legislation.

We shall thus have to consider particularly exotic epidemic diseases and communicable affections of local origin in order to discover the most efficient means of protection against invasion by the ones, and against the development and spread of the others.

Ladies and Gentlemen,—The protection against exotic contagious diseases is based on two theories, each having its staunch supporters.

According to the one, epidemics are due to, or are maintained by, the unhealthiness of the soil; to insure its permanent salubrity is therefore the best means of preventing and suppressing epidemics. England has supported this doctrine, and spent over a thousand millions in cleansing and purifying its sea-ports.

According to the other, the real danger lies in the importation of the morbid germs; therefore, protection is sought in the efforts to prevent their introduction along sea-boards and frontiers, or in other words, in the establishing of an effective quarantine service.

Those two doctrines may be equally true, but separately they are not complete. To secure real protection in accordance with the requirements of modern science, of commerce, and of the financial standing of a country, a just medium has to be adopted by a combination of the two doctrines. What has been possible and successful in England, owing to the small extent of coast and land, and to the isolated position of the country, cannot be so in all other localities; a long coast-line, a large surface of country, and near exposure to infection, would render the sterilization of the soil an enterprise much too expensive and tedious; the immediate help of a strict and intelligent quarantine service is required.

Quarantine may yet be looked upon as horrible and too rigorous for certain commercial and personal interests, but, on one hand, we all have interests to protect,—and the most vital interests; our health and lives; and, again, the quarantine of to-day, with its modern perfection, has been reduced to a minimum and has become simply a station for inspection and disinfection. The name of horrifying alone remains of the past. So, all should bow before the general appeal and the general interests of a country demanding protection; and, instead of obstructing progress, should work actively to help science to render the means at hand still more perfect and less astringent, and invent others more effective and of easier application.

To protect us against fire, accidents, and crime, the law demands of us certain requirements that do not always suit our views or funds; but, for the general good, we are obliged to yield. Should not the law be even more inflexible and powerful with regard to the dictates of the apostles of Hygeia, that benevolent daughter of Esculapius and protecting goddess whose sole care, like ours, was to watch over the health of mankind and prolong the existence of each of its beings?

By thus judiciously combining the two doctrines, we may hope to secure almost absolute immunity, and, at the same time, reduce to a minimum the exactions of quarantine and other rigorous measures; commerce and hygiene may thus be brought to an harmonious understanding, and, hereafter, work in concert.

The calm with which we have witnessed, for the last three years, the menaces of cholera; the success with which it has been repulsed from this continent up to now; and the effective protection against yellow-fever, provided throughout the Mississippi Valley during these last ten years, by the model quarantine of New Orleans, prove not only the progress accom-

plished and the efficacy of the actual system of quarantine, but also, the confidence and co-operation of the intelligent public. This is a great step towards success. Let the good results of our labors be repeated and publicly brought out, and our humane instructions and exactions will soon appear less barbarous.

There is still room for progress, both to oppose the introduction of germs and to purify and sterilize the soil, so diminishing danger, and at the same time, commercial restraint. Among other things, navigation requires looking into. Is everything done by our great steamship companies, usually so interested, to facilitate our arduous task? Is the sanitary protection afforded, sufficient? Have they on board all their vessels, every suggested and available means of stamping out a budding disease and thoroughly destroying its effects? Have they methods of isolation and disinfection sufficing to protect healthy passengers and save from infection the ports they enter? Are they sufficiently under the control of health regulations? Those are questions that deserve our attentive study.

Ladies and Gentlemen,—Communicable diseases that arise on our soil, particularly variola, typhoid fever, and tuberculosis, have already often been the objects of our labors, and the results obtained, both as regards study and practice, have proved that they may be classed among preventable diseases.

Variola, so frequent and disastrous among us, has been vanquished and is now kept in abeyance. The number of its victims, so numerous but a few years ago, has considerably decreased; and, in a short time, we hope it will be an exception to hear of any.

This death-dealing, beauty-destroying scourge will have succumbed to three inflexible agents:—vaccination, isolation, and disinfection. We shall have won in the energetic fight against this fell disease, the gratitude and co-operation, not only of the general public, but more especially of the ladies, and this latter consideration means success to other measures of public health.

The experience of the last fifteen years has proved that the mortality from small-pox is inversely in proportion to the success of vaccination. In countries where vaccination and re-vaccination are obligatory (Germany, etc.), it ranges from 1 to 2 in 100,000; while in those in which the preservative is less enforced it reaches from 32 to 150. Such statistics are the best argument in favor of obligatory vaccination and re-vaccination. To convince every one of the necessity for such measures, we must (1) remove all apprehension or reality of danger, and (2) prove by stern facts and figures the good results obtained. The first consideration brings us to the importance of adopting, after careful study and experiments, the best means of obtaining pure lymph and insuring aseptic vaccination. With those agents no doubt need be entertained as to the danger or efficacy of vaccination. The second point requires the compiling of statistics, and especially the wide-spread publication of the good results. In a short

time, by such proofs of utility, the public, and especially governments, will be thoroughly convinced of the urgency of obligatory vaccination and re-vaccination.

Typhoid fever and tuberculosis are even more malignant in their ultimate results than variola or great epidemics of other dreaded plagues, because their action is persistent, insiduous, and universal. The attention of the public and others, is not thus thoroughly awakened to the threatened danger, and no efficient opposition is brought to bear against the ravages of those two devastating diseases. No expense or study should be considered to discover means of fully arresting the action of those scourges; the demand is urgent; the answer vital.

It is deplorable to see the continual ravages of typhoid fever among young people; it seems to maliciously devote itself to cutting off in the prime of life the more healthy and useful subjects; in the end, the result is a most disastrous loss to the community.

Water being the one great medium of its spreading, all efforts should unite to obtain pure water-supplies. The cause and the remedy being known, it is the duty of interested persons and governments to procure such help from sanitary engineering and elsewhere, as will give the desired results. Do our municipal councils realize their responsibilities in this matter, and are they fully alive to their duty? We have before us to be imitated, the examples of the Romans and Ancients, who drew back before no expense or labor, time or distance, to obtain wholesome water, and who built in every country where they ruled, those monumental aqueducts which still excite our admiration.

This points to the urgency of developing and perfecting the study of sanitary civil engineering. It is a science that should be afforded all means of progress,and quickly placed in a position to give its much needed powerful help to the cause of hygiene.

Among all the diseases that have been the subjects of our labors, actually none forces itself more pressingly upon our zeal, than tuberculosis. This implacable affection, that may be rightly termed the scourge of mankind, continues, despite all science and philanthropy, to persistently thin the ranks of mankind, and reap its deadly tribute from every family. To it alone is due the enormous proportion of one-sixth of the deaths from all causes.

Thanks to the discoveries of modern science, we now know that this disease is produced by a germ or microbe; consequently that it ranks among contagious diseases and is amenable to hygiene. The resources of sanitary knowledge must therefore be immediately brought into action to perseveringly check its destructive operations.

We are aware, at the present, that contrary to what has been believed up to those last years, the disease is rarely hereditary, and nearly always acquired. We know also that the germs, once set at liberty by the dessication of the sputum of consumptives, are to be found almost everywhere; that we

absorb them with the air we breathe, and may ingest them in certain foods; milk, butter, cream, or the meat of tubercular animals.

But it is also proven that, even if such are the principle modes of transmission of the germs of this terrible disease, nevertheless, they can implant themselves and evolve only in a favorable pabulum; that is to say, in a predisposed subject. This predisposition in the person may be either hereditary or acquired from the dwellings and surroundings in which we live, from our occupations, from certain diseases that we may have, or from certain causes that weaken and undermine our system.

Possessed of this knowledge, we may undertake the combat with courage, as we know in what direction to turn our efforts. We must find and reveal the best means not only of preventing the dissemination of germs in the air and their ingestion with food, but also of rendering ourselves refractory to their action and of correcting any existing predisposition, whether hereditary or acquired; for, with the greater number of contagious diseases, the great point does not appear to be only the hunting out and destroying of the germs, but the placing of the system in such a condition that it may with impunity receive their attacks; give them no ground to work upon or to feed upon; in a word, "starve" them out.

The enormous destruction of health and life caused by those three last mentioned diseases and the losses entailed by countries and commercial interests, demand the immediate and cogent interference of governments and municipalities. I again repeat that expenditure is necessary, but there is no excuse for refusing it for such urgent protection.

Ladies and Gentlemen,—Not wishing to review all the contagious diseases and sanitary questions that have been and still are the objects of our work and debates, I will simply draw your notice to another question or two which demand the immediate attention of the Association and the co-operation of the public: I mention food adulteration, alcoholism, and vital statistics.

Food adulteration is, I should say, in most cases, a crime deserving the severest punishment; it is fraught with danger, and is an important factor in the increase of premature mortality, especially among children. Even when life is not immediately endangered, a chronic intoxication is often produced that insidiously and irreparably undermines the health of many a human being, both young and old.

Urgent appeals should be made to the press, to boards of health, boards of trade, and governments to raise their warning and protective influence to eradicate such criminal procedures. Municipal laboratories should be established throughout the land for the detection of such fraudulent doings, and justice should deal rigorously with all offenders.

Could there not be a general understanding, so that in each country, each state, and each province on this continent, the same uniform methods of analysis be employed, and the same unwholesome products receive universal prohibition?

Alcoholism is the plague of many northern climates, and we are not without participating in its dire influences. It should not be allowed to escape our vigilant attention, for it is the ruin of health, of society, and of a nation. The Fates point to the gloomy picture of ancient times, but the experience of the past does not seem to have succeeded in rooting out this terrible evil, which is the harbinger and entertainer of the greatest part of all crime and vice. Alcoholism has for its share more than half the occupants of our prisons, hospitals, and lunatic asylums. Not only do those addicted to drinking intoxicating liquors most of the time throw their entire families upon the state for support, but the latter is also obliged to look after their scrofulous, idiotic, and epileptic offspring, who are incapable of providing for themselves and are often dangerous to society. Their other children, although less affected by the original taint, are generally worthless subjects; lazy, criminal, and degenerate, and form loathsome mediums for the propagation of disease and vice.

Under such conditions as these, and with such dreadful results, we pay too dearly the money that enters the coffers of the state or municipality under the title of tax or license. It is simply speculating on vice, on the ruin of wealth, health, and talents, and such speculation is in no wise justifiable, and should not be tolerated under any consideration. By every means in our power this plague should be opposed and if possible exterminated; it is more deadly than contagious diseases and more difficult to deal with. The problem is one for serious study and painstaking measures. Good work has already been done, and if the desired result has not yet been attained by the measures advocated and tried up to the present, let us not be discouraged, but set to work again. Let us find out if there are no other ways of succeeding. Are men sufficiently educated in their childhood on the dangers and terrible consequences of indulging in the use of liquors, even in a social way? And in this as in all other matters of hygiene, why not ask more of education and not trust exclusively to legislation?

To insure the success of the sanitary reforms dictated by the progress and discoveries of modern hygiene, we must obtain the good-will and co-operation of the public. For this purpose, we must set before them plain facts and figures, problems solved and strikingly exposed. It is then of paramount importance to unite our efforts so as to bring each of our national governments and each of our states or provinces to possess and adopt a complete and uniform system of vital statistics, in order to bring out such convincing evidence as will happily impress the public. Plain numbers alone are often sufficient to awaken them to a state of things they did not surmise. In those statistics should be included not only city districts, but rural divisions also; for alas! in the country there are still many sad conditions of unhealthiness and ignorance that require to be relieved.

Such are the principal questions which, with the unmentioned contagia: diphtheria, measles, scarlatina, and others, the protection of infantile

health and life, the destruction and utilization of garbage and refuse matter in large centres, the purifying and sterilizing of the soil, the action of pathogenic germs, the pollution of water supplies, etc., are to be submitted to our study. I feel confident, that with such a programme, this congress will bring forth as happy results as those of the preceding ones; nay, as we are always progressing, we may hope for even more.

The perspective of the future is thus very encouraging. The work done during the last fifteen years has been enormous; what may we not then expect of the next fifteen years? All over the continent, state, provincial, and local boards of health have been organized and are working effectively; associations, conferences, and conventions are studying the most actual and urgent problems of public hygiene; everywhere, already, a prominent position is given to the teaching of sanitary knowledge; universities and schools obtain the services of competent and distinguished teachers, and are being rapidly equipped with laboratories of sanitary science; every city or district will soon have, if it has not already, its municipal laboratory worked by competent specialists.

The practical scientific working is now created and advancing. The generation that succeeds us, luckier than we in this respect, will be in possession of all that is needed to insure success; we shall drop out wishing them courage and perseverance, and be happy if we can claim to have contributed according to our means to prepare the way for them and render less ungrateful the task we bequeath them.

Without fearing to counteract the designs of God, we may continue to utilize the talents He has given us, in seeking the best means of protecting our health and lives and of attaining the average of longevity.

Without wishing to frustrate the decrees of his Supreme Justice, let us not forget that contagious diseases and epidemics, although they may in a measure serve as punishment for the waywardness of man, are most frequently the outcome of his errors and ignorance in the preservation of his health, and, as such, they should be struggled against. The protection and preservation of one's health and that of one's fellow-beings is not only a right but a solemn duty.

My Dear Colleagues,—As President of the Association, I cannot close this address without acknowledging the zeal and perseverance shown by the Local Committee of Arrangements in the organization of this Congress, which they have so largely contributed to make a success; I am happy, in the name of the Association, to express our gratitude to each of them, especially to their devoted Chairman and Secretary.

To the distinguished statesmen who honor us with their presence, to the citizens of Montreal who are here assembled, and to the ladies who so largely contribute to the brilliancy of this formal opening of our Congress, the Association is grateful. Their presence proves the interest shown in our proceedings and is a powerful encouragement to our labors and a guarantee of further success for sanitation.

To the Press— that true and powerful friend of hygiene—we also owe our gratitude for the interest it has always taken in our meetings and the publicity it gives to our work.

Ladies and Gentlemen, I again renew my thanks for your kind attention and forbearance.

ADDRESS.[1]

By Dr. ROBERT CRAIK, Chairman Local Committee of Arrangements, Montreal, Canada.

Your Excellency, Gentlemen Delegates, Ladies and Gentlemen: The object which brings us together here to-night is one which concerns every member of the community, whatever may be his age, creed, occupation, or nationality, and whether he or she may take any interest in it or not. It is to introduce to our Montreal friends a body of eminent men coming from all parts of this continent, from distant Mexico and from every part of the United States and of Canada.

The American Public Health Association which is now in session in this city was established many years ago in the United States, having for its object the study and the public discussion of all those measures and processes which may assist in preserving the lives and the health of the human race, whether as individuals, families, communities, nations, or mankind in general.

The basis of the organization was made so broad as to include the whole continent of North America so as to invite coöperation with Canada, Mexico, and all other communities which might be within reasonable reach, and its roll of membership includes the names of nearly all the sanitarians of eminence on this continent.

Canada was not slow to recognize the power for good which such an organization offered, and has taken a prominent part in its operations. Canadians prominent in health and sanitary matters have from time to time occupied important positions among its officers, and our distinguished sanitarian and fellow-townsman, Dr. E. Persillier-Lachapelle, president of our Provincial Board of Health of Quebec, has this year been its president, and it is largely to his influence and to the appreciation of his great gifts as a leader in matters connected with public health, that we owe the gratification of seeing the Association working in our midst to-day.

Our citizens have ever been quick to show their appreciation of any honest effort in the cause of humanity, and have never failed to welcome gladly those who have come amongst them with benevolent intent. It gives me much pleasure therefore, on behalf of our local committee, to extend to the American Public Health Association and all members and delegates associated with it, a cordial and hearty welcome, and a special welcome to those members of the gentler sex, the ladies of the party, who have graced and honored us with their presence, and whose charming coöperation will be cherished among the most precious of our memories.

[1] Delivered at the formal opening of the twenty-second annual meeting of the American Public Health Association, Montreal, Sept. 25, 1894.

To all of you we offer our good wishes. May your sojourn among us be pleasant, may your deliberations and discussions be fruitful of good to the cause which you have at heart, and may you carry away with you the conviction that although this climate of ours may sometimes be cold, the hearts of its inhabitants are never cold to those who come to them as friends and neighbors, or who claim their sympathies and their coöperation in the great work of relieving or mitigating human suffering.

It may be well to explain that this Association is not a society of doctors, though physicians naturally take a prominent part in its work, but it extends its membership to all persons of respectability whose duties or inclinations bring them into contact with questions pertaining to public health. The work of curing diseases may properly be left in the hands of doctors and nurses, and it is a noble work, but inasmuch as prevention is better than cure, the prevention of disease, which is the special function of this Association, may be looked upon as higher and nobler still, Let us all, therefore, unite in helping on the work of this Association, by adding largely to its membership, and by taking an active interest in its proceedings; and let us, regardless of all artificial lines of separation, join together as one great family, striving earnestly to prevent as far as may be, human misery, disease, and premature death, and to increase by every means in our power the sum of human health, happiness, and prosperity.

ADDRESS.[1]

By Hon. J. A. CHAPLEAU, Lieutenant-Governor of the Province of Quebec.

Mr. President, Ladies, and Gentlemen: I was just saying in French that the Governor has no right to speak, he has only the right to sign. I would have been proud to have had the privilege of signing the address of welcome which has been delivered by chairman of your local committee, but it would have been robbery. I could not have signed it for the reason that the Governor is not responsible for what he says. [Laughter.]

Mr. Chairman, I am happy as Governor and Chief Magistrate of the Province of Quebec to welcome you as the members of the American Public Health Association to Montreal at this time. I am glad to give you that welcome. People have said somewhere that in Montreal they received what might be termed exaggerated hospitality. No, Mr. President, Montreal's hospitality is not exaggerated. Montreal has the reputation of being generous and cordial in its hospitality, and has been termed the great polite, courteous city of America. Your Association, I think, held its last meeting in Mexico. Those who have read the reports of the receptions there know what a delightful time you had during your visit to that city. Mexico has received delegates from all parts of the world in the most gracious, hospitable manner. Montreal will, and does, do the same. It is not for me, gentlemen, to tell you how beneficial, how great, are the objects of your Association. There may be congresses of labor, congresses of peace; there may be assemblages of people coming to discuss the great benefits that might come to mankind from this, that, or the other thing, but there cannot be a better congress than a gathering of men who want to know and want to give others a knowledge of what the public health is in this world. [Applause.] We are threatened every day with diseases. People are saying that the length of life of humanity is decreasing. There is nothing in that; but there is one thing that is being done by your Association, and that is to prevent the coming to our country and into the world of the great plagues, which in the last century were the dread of humanity. The questions you are called upon to discuss are important. I would not dare to speak of them. I can tell you a good word about doctors. I have been a sick man for the last fifteen years, and they have done a good deal for me. I speak of the doctors of humanity, and your Association is made up of this kind of material. The scope of your deliberations is large; when we take into consideration that you have to deal with such subjects as the purification of water supplies, the adulteration of food, the utilization and disposal of garbage, the purification of the sewage system of our cities, it is a field so wide that I could not enter upon it. The members of your Association will do that.

[1] Delivered at the formal opening of the Twenty-Second Annual Meeting of the American Public Health Association, Montreal, September 25, 1894.

What can I add to what I have said, in saying that I extend to you a hearty welcome to our city? The benefits of your labors, your discussions, and papers that you are going to publish which can be read by municipal, local, and federal government authorities to try to pass measures which you are suggesting to them, are subjects worthy the attention of every one.

The chairman of your local committee has said that Montreal had come forward and assisted the Association which has first organized in the United States. I think I am not paying a compliment to one of the members of your Association in telling you that the first medical board of public health that was ever organized in Canada was by Dr. Hingston. It was about twenty years ago. The president of your Association, Dr. Lachapelle, has been following in his steps. Everybody has been assisting them, and I consider it the first duty of a government to assist boards of health, and as long as I am governor of the Province of Quebec the first duty of our government shall be to assist you in your endeavors to keep the public health as high as it ever can be kept. [Loud applause.] You have an extensive field before you. You are equal to the duties that are imposed upon you. There is no need on my part to refer to what you can do in the prevention of the spread of epidemic and contagious diseases in our cities. I just found by accident a newspaper clipping which will give you an idea of the scope of what can be done in preventing people from having food which is not pure. It is this:

"Placid am I, content, serene,
I take my slab of gypsum bread,
And chunks of oleomargarine
Upon its tasteless sides I spread.

"The egg I eat was never laid
By any cackling, feathered hen;
But from the Lord knows what 'tis made
In Newark by unfeathered men.

"I wash my simple breakfast down
With fragrant chicory so cheap;
Or with the best black tea in town—
Dried willow leaves—I calmly sleep.

"But if from man's vile arts I flee
And drink pure water from the pump,
I gulp down infusoriæ,
And hideous rotatoriæ,
And wriggling polygastricæ,
And slimy diatomaceæ,
And hard-shelled orphryocercinæ,
And double-barrelled kolpodæ,
Non-loricated ambrœilæ,
And various animalculæ;
Of middle, high, and low degree;
For nature just beats all creation
In multiplied adulteration."

This is what we eat, and this is the way we live. It is no joke. It is a serious matter.

It is with a high sense of duty that I welcome such an intelligent body of men as this—men devoted to science, to the prevention of diseases, trying to assist and work in behalf of humanity. I say, long live such noble men, who are the embodiment of all that is just and pure and good. I am sorry that I am not equal to the task of delivering an eloquent address, but I trust one of my ministers will be good enough to supply my wants. [Applause.]

After listening to the able address of your president, Dr. Lachapelle, I cannot permit the opportunity to pass without telling you how grateful the people of this continent ought to be to him for the devotion he has given to this work. When you know that he is giving the greatest part of his time to the work of his life with reference to matters bearing on the public health, with no salary except the paltry sum of $300, you can appreciate his untiring energy for the welfare of the public. Men are paid several thousand dollars a year as salary for no more work than he has done, and a man devoting his time and attention in this way deserves from the magistrate of the province this recognition, and I ask, Mr. President, that a vote of thanks be tendered Dr. Lachapelle for his arduous labors, to show what gratitude he deserves from his country. [Applause.]

[The motion was put and unanimously carried.]

ADDRESS.[1]

By HON. J. O. VILLENEVUE, Mayor of Montreal.

To the Members of the American Public Health Association.—

Gentlemen: Permit me, on behalf of the citizens of Montreal, to extend to you all a most cordial welcome to our city. You have assembled here to hold the 22d annual meeting of your organization, and I assure you our city considers itself honored by your presence.

Your Association, considered in its objects and in the result of its labors, is one of the most important on the American continent. Favor by every possible means the progress of science in matters of hygiene, see that everywhere practical measures are adopted to prevent sickness and epidemics,—these are the objects of your Association, and one cannot but acknowledge that such objects are noble, useful, and humane.

The all importance of public and private hygiene is now admitted by everyone, and no person will deny that both these branches of medical science are very closely connected. They are connected not only with the health and welfare of the universe, but as well with the commercial and financial condition of cities and countries. The sanitary and commercial interests of the world are dependent upon one another, because when an epidemic breaks out, commercial transactions are stopped at once, misery and hardships are the consequence, and who will deny that misery gives birth to sickness. It is, therefore, with reason that hygienists give their undivided attention to the commercial interests of the world, because when these are prosperous, public health is sure to derive great benefit therefrom.

Your Association possesses an especial character of philanthropy and universality, because all its efforts tend towards the preservation of humanity from sickness and contagion. Such devotedness to the interest of your fellow citizens is worthy of admiration, and for that reason, alone, I might consider myself especially honored at being called upon to bid you welcome to Montreal.

I therefore pray you to consider yourselves at home in our city, the commercial metropolis of Canada, and I sincerely trust that your convention will be fruitful, and will result in doing good to yourselves as a body and to the community at large.

You may rest assured that one and all the citizens of Montreal appreciate fully the honor you have done them in selecting their city as the scene of the present convention, and that whatever destiny may have in store for you, the good wishes of our people will always accompany you.

[1] Delivered at the formal opening of the Twenty-Second Annual Meeting of the American Public Health Association, Montreal, September 25, 1894.

ADDRESS.[1]

By Hon. LOUIS P. PELLETIER, Secretary of the Province of Quebec.

Mr. President, Ladies and Gentlemen: It is with the greatest possible pleasure that I, in my capacity as secretary of the province, extend to you, one and all, the most cordial welcome to this city and to this province of Quebec. I have not failed to notice by the official programme of your daily deliberations, which has been kindly placed at my disposition, that one is free here to choose in public utterance either the French, the English, or the Spanish tongue. In my opinion, Mr. President and gentlemen, you could not have made a happier choice, for in no country in the world would this trinity of tongues be made more applicable than here on this North American continent. I do not forget that it was the beautiful language of Castile and Aragon that was spoken by the hardy mariners of the "Santa Maria" when they braved the dangers of a stormy and unknown sea to bring Christianity and civilization to the New World. It was those soft and beautiful accents heard beyond the Pyrenees that were spoken by that immortal captain, that intrepid discoverer, when, standing upon the quarter-deck of his little ship, he pacified his mutinous crew, and, extending his prophetic hand, pointed out to them the promised land. It was the sweet and silvery Spanish sounds falling from the lips of Ferdinand and Isabelle which inspired Columbus when he took possession of this continent in the name of God, of the queen, and of the king. I ask myself to-night, Mr. Chairman and gentlemen, if the old forests yet standing by the side of our American lakes and rivers and passed over by Chateaubriand in his magnificent flights of poetic fancy have still conserved these delicious souvenirs of a time long since passed, and if the soft murmurings amongst the trees are not the spent echoes of some Spanish ballads of the long ago. This may be poetical, gentlemen, but it may be that the question can be easily answered by the modest *savants* who came to us from Mexico and the other Spanish speaking republic to the south. At any rate, if I were speaking my mother tongue this evening, the question would be asked in a language not less harmonious and rich; a tongue spoken by those who came after the brave men who sailed out from the port of Palos in the service of their country and their God. This is also an official language for the convention, and it should be, because we, French-Canadians, are proud to say that it was spoken by the founder of New France—it was the language of Jacques Cartier, of Champlain, and of Maisonneauve, the founder of this great city, which receives you with so much hospitality and enthusiasm; in a word, it is the language spoken by the vast majority of the people in this

[1] Delivered at the formal opening of the Twenty-Second Annual Meeting of the American Public Health Association, Montreal, September 25, 1894.

province, which says to-day, by means of my feeble voice: "Gentlemen, make yourselves at home; you are welcome to this city and province."

Here is also a third tongue which your programme declares to be official, a language which our loyalty to our beloved Sovereign engages us to learn, and that without ever forgetting our own, a language which is used by our American cousins who live under the star spangled banner, and which is also dear to us, because it is the one in which is written the charter of our religious and civil liberties. It is the tongue which I imperfectly speak to you to-night, and which I have thought better to use in order, as the official representative of the province, to make myself understood by all the members of this great convention.

Gentlemen, you are the apostles of an admirable science, you are, in fact, the pioneers of a mission both social and humane. Providence has brought individuals and people into the world, but it also entered into the divine plan to leave to the humane intelligence the care of contributing in a certain manner to the extra terrestrial work of the creation in safeguarding, as long as possible, our fragile existence.

Man is born weak and suffering. Until this precarious period has expired, God, in his kindness, has placed near him and to tenderly watch over him the unique and loving being called mother. It is, however, when he reaches man's estate and surrounded by all the dangers that menace our earthly existence that you, gentlemen, come on the scene as the protecting sentinels of human life. While the mother bends over the cradle of her child and passes sleepless nights by its side, you sanitarians of the medical profession watch over the larger cradle of humanity and continue God's work of prolonging the life of your fellow-creatures.

Gentlemen, permit me to express my sincere admiration for the roll you play in the world, for your profession, and for your great mission on earth. It has been said that the practice of medicine partakes of a sacerdotal character. The clergyman applies himself to the saving of souls, while the physician seeks to save the body; but if I admire medicine with all its glorious uncertainties, its divergence of opinions, its pains, and its errors, it is impossible not to prefer preventive to remedial medicine. I think I am safe in saying that I prefer the man who prevents me from falling sick to the one who cures me, if he is able to do so. The medical man that treats me finds me suffering and timid. I, in fact, am fearful of his knife that works with so little ceremony in my flesh. I am certainly not well enough inclined in my bed of suffering not to revolt at times even against the fact that in order to snatch me from the grave, the duty to suffer and to suffer much imposes itself imperiously upon me.

You study the causes of different diseases, which, if allowed to progress, destroy an entire population. You see that the supply of water is pure because you are aware that in the water we drink, if it is not of good quality, germinates the gravest maladies. You also work with ardor to bring about a better system of drainage and to see that the air we breathe does not possess germs of disease and death. You also put

forth your best efforts in order that the food that enters into our daily use is good and pure, and that the meat in our markets and the milk which is distributed in our cities are fit for general consumption. You are likewise supposed, in order that you may be the fortunate apostles of science and to have the confidence of those who surround you, to see that the quarantine system is organized in a manner that will preclude epidemic diseases being transported from one country to another.

This, gentlemen, is a noble mission, and I am proud, in the name of the Province of Quebec, to greet those here to-night as the gentlemen who have been charged to carry it out.

I remember well, Mr. President and gentlemen, two years ago when we were threatened with cholera, but we found in our excellent board of health a powerful aid in preventing the epidemic. Our quarantine station at Grosse Isle, in spite of the splendid ability, the high medical attainments, and the frequent suggestions of Dr. Montizambert, was not upon a sufficiently efficacious footing; consequently we took the law into our own hands. We issued, at the request of our health bureau, a proclamation of the most energetic character, in virtue of which we forbade the entering in our ports of all steamers coming from countries where the ravages of the dread cholera were felt. This action on our part had the desired effect, and I profit by this occasion in the most public manner to tender the thanks and gratitude of the country to Dr. Lachapelle and his capable and efficient colleagues of the health department. They in every way showed themselves equal to the emergency, and I must say here to-night, that of all the branches of my department there is not one in which I receive more efficient and powerful assistance than the health bureau of the province, and these gentlemen can say that I have ever been happy to study and carry into effect their recommendations without ever refusing a single one.

We have taken care that you should be well received in this province, and we have placed at the disposition of the health bureau all that is necessary for your comfort. I desire, in fact, that you shall leave Quebec province convinced that you have seen a beautiful country and satisfied with your visit. I shall be glad also to have you visit the old city of Quebec. I do not invite you to see its greatness or its rapid development as a commercial centre, but rather to see the city of glorious souvenirs, for here were fought the last great battles which made New France a colony of the British empire. If you interrogate these old walls, and if you tread upon the historic soil of Quebec during your visit to the grand old city, your mind will not fail to be filled with memories of a grand and glorious past. I may tell you, gentlemen, that since we ceased being subjects of old France, proud Albion has found us amongst her most loyal and faithful subjects. We have erected at Quebec a common monument to French and English generals, both of whom died on the field of battle, and in spite of the fact that we do not all speak the same language, we are all happy to live together beneath the old flag that

ensures to us our national and political existence. We in this province are quickly marching along the road of progress and development, and I have the firm conviction in looking into the future, that we are to become a great people and that our power destiny is already assured. In the meantime we do our best here to give an example of that generosity of spirit and wide tolerance which exist between the members of one community composed of different national and religious elements. Gentlemen, this province is the land of liberty, of tolerance, and of good-will?

We are here in a province composed in majority of French-Canadian Catholics, and we are masters of our destinies in so far as the education and internal life of our people are concerned, the French and Catholic majority of Quebec accords to the minority the right to worship God as their consciences dictate, and to educate their children as they see fit, and in this we are but performing our duty. We are, in fact, glad to discharge this duty, for we are setting a splendid example before our neighbors.

Gentlemen, in conclusion I have the greatest pleasure in joining with his honor the lieutenant-governor in extending to you once more a cordial welcome and to tell you how we admire the work you have in hand, and hope from it the most happy and profitable results to the different countries you represent and to mankind.

HYGIENIC NOTES MADE ON A SHORT JOURNEY THROUGH ITALY IN 1894.[1]

By GEORGE H. F. NUTTALL, M. D., Ph. D.,

Associate in Hygiene in the Johns Hopkins University; Delegate of the American Public Health Association to the International Medical Congress in 1894.

In the following notes I shall have occasion to refer chiefly to hygienic matters in Naples, because undoubtedly that city offers the most interesting conditions.

For many years prior to the cholera epidemic of 1884, the sanitary condition of Naples had been recognized as a source of great danger to its inhabitants. The older notoriously unhealthy portions of the city, especially the districts Vittoria and Santa Lucia, situated near the water-front on low ground, were the parts which suffered most from cholera. The swampy soil in these low-lying districts was literally saturated with the sewage of centuries. Formerly the sewage emptied directly in front of the city into the bay, and, especially at low tide, and in the summer when the wind blew unfavorably for those on shore, the odor was excessively unpleasant. The parts of Naples above mentioned were traversed by very narrow streets, with houses five and six stories high on either side, so that but little sunlight and fresh air could enter them. From these narrow dingy streets the visitor gained access to even dingier courts, the "fondaci," where vice, filth, and the greatest poverty, were visible; the inhabitants being crowded together to an incredible extent. All manner of garbage, and the excrement of man and animals, pollute the alleys and courts—and still make it difficult to pick one's steps in those parts of the city which now are happily quickly disappearing. Over head, on poles and cords stretched in every conceivable direction, washing is hung out to dry across alleys and courts helping to shut out the light. Unearthly yells of peddlers rend the air, children play about in the mire or pelt each other with garbage, whilst herds of goats are frequently driven through the streets to supply the poorer classes directly with milk. When describing this part of Naples it is easy to confuse past and present, for the old is being replaced by the new and all is in confusion. A good picture of the conditions existing in Naples so recently as 1884 is given by a Swedish physician, Dr. Axel Munthe, who resided there during the great epidemic. According to official figures quoted by him, 128,804 of the total number of inhabitants lived either in cellars ("sotteterrani") or low dwellings ("bassi"), where the floors were either of ordinary brick or clay; 9,846 inhabited the gloomy unhealthy courts or "fondaci." The "fondaci" were built during the Spanish occupation in the sixteenth century.

[1] Read at the Montreal meeting of the American Public Health Association.

Several of these courts were frequently connected with each other by gloomy passages with but one common exit into the street or alley. Into the court open small doors by which alone air and light gain access to the dark and filthy interiors, and six to eight people were often crowded into a single room. Screens keeping families apart made several "homes" in larger rooms, the common privy and kitchen often being side by side. During the epidemic the ignorance and superstition of these poor people frequently excluded medical aid. Munthe states, "That a popular belief existed to the effect that doctors received a premium on every cholera patient they were able to report is an indisputable fact. The idea that they were paid by the government for the express purpose of spreading the disease, is now exploded, and I have never heard it broached save in the case of a few old men who had picked it up during the epidemic of 1836; as a rule it has been modified to the extent of believing that the town authorities, desirous of reducing the surplus population (it is in this form that the echo of the long-continued discussions on the over-population of Naples has reached the alleys of the poorer quarters) had *let the cholera loose* in order to give more room! This view was universally held by the people, and was unfortunately often interpreted by acts of hostility and violence."[1]

The disastrous epidemic of 1884 compelled decisive action. The city being too poor to defray the expenses of an undertaking of such magnitude as was proposed, and necessary, the government was obliged to vote one hundred million francs toward the sanitary improvements. It was decided to introduce a new and pure water-supply, to construct proper sewers, to demolish and reconstruct on a higher level the worst part of the city, thus enlarging the street area and to provide buildings on the outskirts of the town for the accommodation of the moved population. This enormous undertaking fraught with great practical difficulties, has been fitly called the "sventramento" or disembowelling of the city of Naples. Of 504,700 inhabitants 6,971 or 1.38 per cent. died of cholera in 1884. The mortality was greatest 116.13 :1,000 in the poorest districts of Porto, Pendino, Mercato, and Viccaria, which are included in the "sventramento." These parts cover an area of 980,686 square meters. All houses of unsanitary construction are being torn down, and new buildings answering hygienic requirements put in their places. Where it is possible old buildings are preserved or altered. In walking through the yet undestroyed or altered parts a horizontal line painted along the house-front indicates to the observer the level of the future streets. As this tearing down and filling up goes on, consid-

[1] "Letters from a Mourning City" (Naples, autumn 1884,) by Axel Munthe, translated from the Swedish by Maude Valérie White, London, 1887. John Murray publisher.—In the following article I have made free use of various official reports as also of a paper by Th. Weyl "Die Assanirung Neapels" Deutsche Viertelyahreschrift F. öffentliche Gesundheitspflege, Bd. 26, Hft. 2, 1894. I wish to express my indebtedness here especially to Dr. Giacomo Bessone, provincial physician, for much attention and kind personal guidance in the inspection of hygienic matters in Naples, and also to Prof. H. J. Johnston-Lavis for assisting me to visit the water-works, and giving me a variety of useful information. In Florence the provincial physician, Dr. Giovanni Loriga was also most courteous, giving a great deal of time to showing me what was best worth seeing in that city.

erable difficulties have to be encountered to secure an effective provisional drainage, to guard against the collapse of dwellings, etc., and it is natural that some accidents should have happened. At times the line indicating the future level runs only a few feet above the present sidewalk, at other times as much as eight meters higher, so that which is at present the first floor, in those houses which are permitted to remain, will form the ground-floor later on. One street, shown me by Dr. Bessone, was half filled longitudinally to the new level, the made ground being held in place temporarily by a wooden bulkhead fully seven meters high. No description can convey the impression this huge hygienic experiment makes on the beholder. On one side are the old houses, reeking with the filth of centuries, now standing isolated or half cut through, and for the first time since they were built, reflecting an honest ray of sunshine—on the other clean new houses and broad streets, which appear all the brighter for the contrast.

Between eight and ten thousand day laborers have found employment here for years. In the reconstructed parts the street area has increased 29 per cent., and the built surface proportionately diminished, together with the population which originally lived here. About one-seventh of the population of Naples, 87,000 people, have been affected by these changes. Of these 69,000 have had to seek new dwellings and 18,000 to temporarily change their abode. Of the total number moved 46,000 belong to the poorest classes. The area occupied by the 87,000 people in the old districts, will, when rebuilt, only accommodate 56,000. A great advantage must result from thus thinning the population, the excess being accommodated in the new quarters built on the outskirts of the city. The new houses present a fine appearance and are suited to the needs of the working classes for which they are planned. The streets in the new quarters are broad and sunny, and have been built in the direction of the prevailing winds. I was assured that something approaching habits of cleanliness have appeared amongst the people transferred to these quarters, and certainly the streets are much cleaner, the bright open courts look attractive and neatly kept.

THE WATER-SUPPLY.

We will first consider the water-supply of Naples. In ancient times the magnificent Claudian aqueduct supplied the city with water from the Serino springs, situated in the foothills of the Apennines, at a distance of some 90 kilometers from the city. This aqueduct fell into disuse many centuries ago. After the aqueduct was allowed to go to ruin, Naples drew its water-supply from two sources, the Bolla, fed by springs situated on the plain which lies between the city and Mt. Vesuvius, and the Tsclero, a small stream originating in the Apennines, the waters of which were conducted to the city in the Carmignasco canal, which was dug in 1629. The Bolla water supplied the lower, the Tsclero, the more elevated, portions of the town, but both sources together only supplied

Naples with a total of 40 liters of water a day for each inhabitant. This water was notoriously bad, and all strangers visiting the city were warned not to drink it.

The new water-supply has existed since 1885. The advisability of repairing the old Roman aqueduct had often been considered, but the idea was ultimately abandoned, as it was found possible as well as advantageous to conduct the Serino water to the city by a more direct conduit. In 1881 the "Naples Water-Works Company," which had previously constructed the water-works of Spezia, Venice, and Bergamo, began the work according to plans by Bateman. The great work was completed in March, 1885. Contamination at the source of supply is excluded and the conduits are covered all the way. On reaching the plain the water empties into three tanks, whence it is syphoned out by three large pipes. Two of these pipes measure 80 cm. in diameter, and conduct water to a reservoir which supplies the middle and lower town. I was informed that they are the two largest syphons of the kind in existence. The third pipe, having a diameter of 70 cm., supplies the reservoirs above the city.

The new water is very plentiful and constant in quantity. The capacity of delivery is 172,800 cbm., or 300 liters a day for each inhabitant. All of this is not used, as 100,000 cbm. or 200 liters per head has been found fully sufficient, that amount being, in fact, five times the quantity formerly supplied to the city. The water is of the purest quality, and reaches the city, even in summer, at a temperature averaging about 11° C.

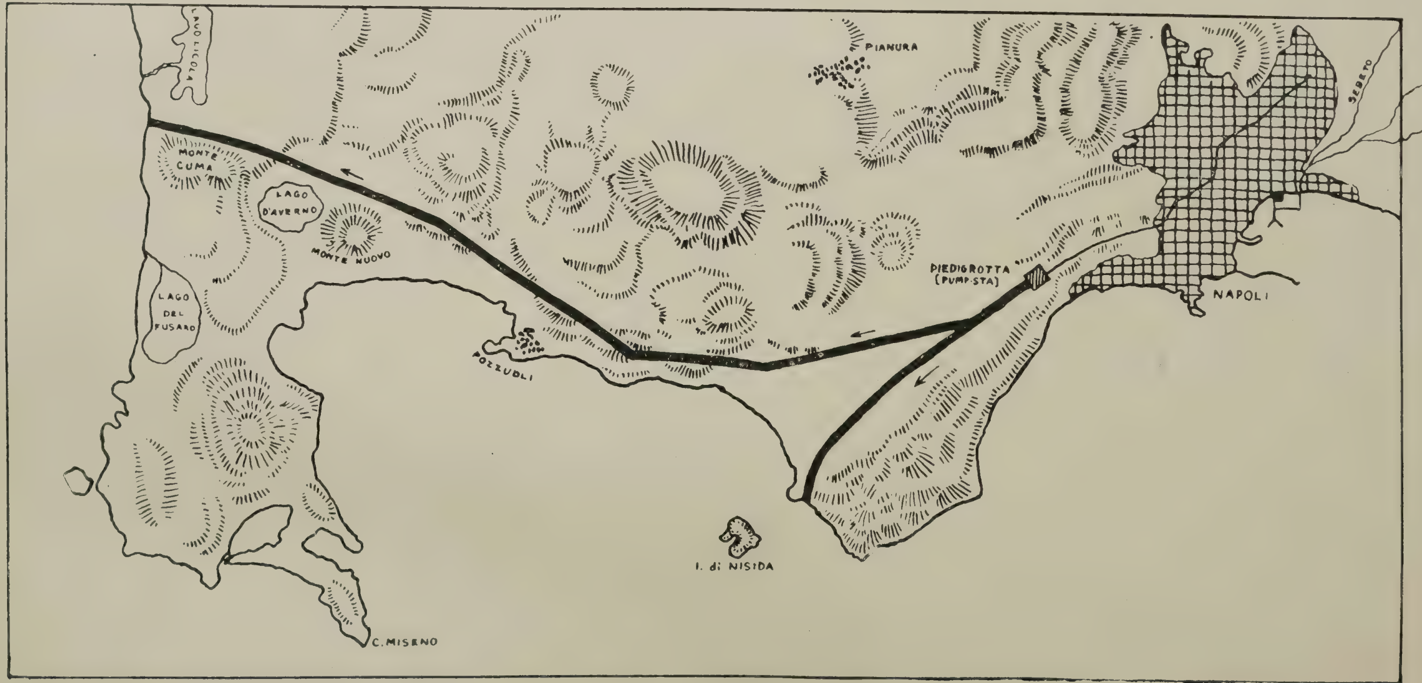
The reservoirs which supply the upper town are certainly remarkable, and approach hygienic perfection as far as is possible. They are excavated in solid volcanic rock (tufa) 50 meters below the surface, near the summit of a hill, Capodimonte, which rises high above and back of the city. The reservoirs are in the form of five parallel tunnels, connected so as to form three reservoirs which taken together have a storage capacity of 80,000 cbm. The descent to the level of the reservoirs is made by means of a broad, spiral staircase built of stone. The reservoirs are egg-shaped in cross-section, 10.8 meters high by 9.25 meters wide, but of different lengths. Owing to the hardness of the rock, but little masonry was required in the construction. The pipe supplying the reservoirs ends in a canal which runs across the ends of the reservoirs to a receiver into which the city-supply pipes open. By this arrangement the water can, if necessary, be conducted directly to the city without first flowing into the reservoirs. Of the five tunnels, one forms of itself a reservoir, while the other four are connected two and two by broad, cross channels. Ventilation is secured by means of several shafts leading to the surface. The cross conduit above referred to is situated in the uppermost of three galleries, and is naturally on a higher level than the reservoirs it supplies. In the second gallery, on a level with the reservoirs, the construction secures the even distribution of the water, and makes it possible to cut off any particular reservoir in case either repair or cleaning is necessary.

The third and lowest gallery takes the overflow which drains into the sea. The advantages of this generous supply of excellent drinking-water cannot, of course, be overestimated.

THE DRAINAGE.

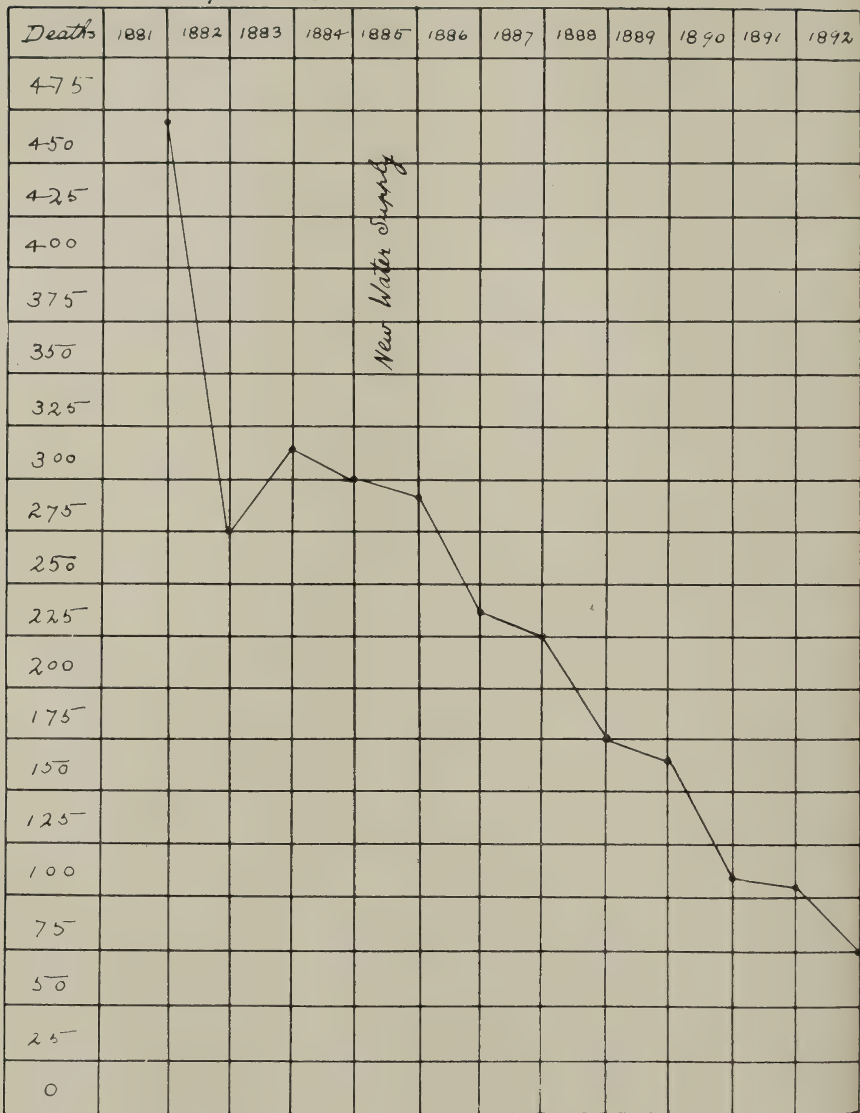
Naples had never been properly sewered. What hitherto served as sewers were drains built by the Spaniards to conduct rain-water to the sea. Cesspools received all the sewage, and gradually the rain-drains were more and more utilized for this purpose. These drains were often obstructed, leaky, and difficult of access. The soil in the lower part of the town became saturated with sewage from cesspools and leaking drains, receiving in addition, all manner of filth from the upper town each time it rained. Alongside of cesspools cisterns for rain-water were often encountered. The ground-water of the lower town was almost on a level with the pavement, as there was no fall toward the sea to make effective drainage possible. It was manifestly impossible after the cholera visitation of 1884 to allow such a condition to continue. All the lower parts of the town were included in the huge task of improvement. The level of the soil in the whole lower condemned portions of the town had to be raised on an average of 4 meters, to secure an effective fall and drainage. The old drains which served as sewers are now abandoned, and the sewage instead of emptying along the water front is conducted westward by several large sewers, placed at various levels, in which the sewage and rain-water flow separately. These main sewers come together near the large pumping-station of Piedigrotta (see accompanying map). The sewage and rain-water are there pumped into a reservoir and pass thence into two conduits, the one 5,313 meters long (with a fall of 4.5 meters), conveying mostly rain-water to the sea, at a point opposite the island of Nisida, the other 15,655 meters long (with a fall of 11.5 meters), erected at a cost of six million francs, conveys the sewage to the sea at Cumae. Instead of allowing the sewage to empty into the sea, sewage farms may possibly be formed in the future about Cumae, where the soil, though at present barren, is well adapted for the purpose. Owing to the sudden and heavy rainfalls, which take place twenty to thirty times a year, overflow drains are necessary within the city to conduct the excess of rain directly into the bay. Another pumping-station in the eastern part of Naples raises the sewage from the low-lying parts so that it may flow into the main sewers which lead to the Piedigrotta pumps.

The Public Office of Hygiene ("ufficio d'hygiene"), founded in 1889, has done signal service in Naples. Such institutions with conjoined hygienic laboratories are being established in all Italian towns of sufficient importance, the direction being placed in the hands of competent scientific men. Besides the activity of the office in the "sventramento" of Naples, the adulteration of foods is controlled by examination in its laboratories. Wine and olive-oil, the chief products of the surrounding country, require the most vigilance.



Drainage of Naples.

Naples Typhoid Fever Curve



The accompanying curve of the typhoid mortality in Naples for eleven years, ending 1892 (the last published report of the provincial physician), shows the decided influence of the late sanitary measures which I have endeavored to make clear in the preceding pages.

ROME.

Modern Rome is supplied by four aqueducts yielding the plentiful daily supply of 600 liters a head. A good deal of this water goes to supply fountains—the amount going to one alone, the Fontana Trevi, being sufficient to supply a respectable community. Though it is delightful and refreshing to see the numerous fountains playing, the idea strikes one that perhaps it would be better if a little less water played in the fountains, and a little more were used in the households and on the persons of the people. How far behind the ancient Roman cities are in this respect our modern ones all over the world! What is Rome of to-day with its four aqueducts and occasional fountains to the Rome of the year 330 which could boast of 19 great aqueducts, 11 thermae, 856 baths, and 1,352 fountains? The thermae of Caracalla alone were capable of accommodating at one time 1,600 bathers, and we need but to see the magnificent ruins that remain of a few of these baths, or of the great aqueduct running in various directions over the broad surrounding campagna, to realize how the Romans loved pure water and plenty of it. The water-supply of to-day is plentiful enough to keep the sewers well washed out. Three main sewers or collectors have been built of late years along the banks of the Tiber, two on one side and one on the other. These sewers empty into the Tiber some kilometers below the city. The banks of that stream, once in picturesque disorder, are being altered by extensive embankments, averaging 14 metres in height and built of fine large quadrangular blocks of travertine. The cost of the embankment wall is reckoned at 30 francs a square meter. The sum of one hundred million francs was voted by the government to defray the expenses of the great alterations made along the course of the Tiber. The ancient Cloaca Maxima has not been condemned —it will go on as of old emptying its contents into the golden Tiber— modern experiment having proved that its relatively small contributions are rapidly rendered harmless by dilution in the stream.

Rome possesses first class and extensive hygienic laboratories, a great new hospital of which it may well be proud, a *modern* city disinfection establishment, and fine, well-kept slaughter houses. The city also has a cemetery to which I shall refer presently.

FLORENCE.

Florence is doubtless the cleanest city in Italy. It draws its water-supply from the Arno. I visited the disinfection establishment, the slaughter houses, and some of the hospitals. The disinfection establishment is new and modelled essentially after the German type, and is supplied with steam disinfectors manufactured in Turin. The establishment

lies on the outskirts of the city and was put up at a moderate cost. The price of disinfecting is moderate. The slaughter houses are large and well kept, but show scarcely anything peculiar, excepting that feature of slaughter houses in general in Italy, namely, an establishment where rheumatic and other patients bathe the affected parts in tubs of various shapes, which are filled with the warm contents of the alimentary canals of cattle just slaughtered. It is also not infrequent in Italy to see chlorotic girls drinking fresh defibrinated blood warmed to the body temperature—a form of treatment which none go through without repugnance. Blood is not used for the manufacture of sausages as in Germany, at least I was told so in the slaughter houses at Florence. The blood here is converted into manure. It is allowed to coagulate in the receiving pans, then it is cut up and mixed with charcoal. The mixture is allowed to dry by exposure to the air in wooden sheds. When dry it forms a friable, inodorous black mass having somewhat the appearance of coke. It sells at the rate of 18.5 liras the quintal. The hair is removed from slaughtered pigs by singeing over a fire, the idea prevailing that scalding the body for that purpose injures the meat. No condemned meat can be sold as food even after it has been boiled. A veterinarian sees that the meat is first rendered harmless and that it goes to the knacker. In connection with the slaughter house is also the dog-pound. Dogs are killed by being placed in air tight iron chambers, with concrete floors, in which there is a brazier with burning charcoal. The authorities consider this method in every way the most satisfactory. Special cages of very practical form exist for rabid dogs. The cages can be divided into two compartments, one air-tight (the suffocating chamber), by a vertical sheet iron slide, making it possible at any time and without danger to the attendant to destroy the animal therein confined.

CREMATION.

In conclusion a few words about cremation. Although the number of persons cremated in Italy has steadily increased, yet the total number as compared to ordinary burials is very small. It must be remembered that the first crematory was built only in 1876, in Milan, and that it takes a long time to crowd out old customs, and even if people are convinced, it is needless to say many are not, that cremation is the best mode of disposing of the dead, it will take many years before it will be generally adopted. Following Milan came Lodi with a crematory built in 1877, then Rome, Cremona, and Brescia followed in 1883, then Padua, Udine, Varese, Spezia, Novara, Florence, Leghorn, and Pisa in 1884, Como in 1886, Asti, S. Remo, Turin in 1887, Mantua and Verona in 1888, Bologna in 1889, and Modena in 1890—making in all, up to that date, twenty-one towns in which crematories are found. In the Campo Santo at Milan the process of incineration costs forty francs. The poor are cremated free. Two methods are employed in Milan,

that of Gorini, which takes two hours with a consumption of forty kilos of coal, and that of Venini, which lasts fifty minutes with a consumption of three hundred kilos of wood. These figures were given me by the men in charge of the establishment. In Rome a first class funeral with cremation ("Se il trasporto del cadaveri vien fatto con pompa di Iª Cl.") costs 100 liras, second class sixty liras, third class forty liras. In Milan, between the years 1876 and 1889 there occurred 679 cremations. In Rome from 1883 to 1893 there were 545 (400 men and 145 women). The yearly cremations in each city number at present between 60 and 70.

POSTSCRIPT.

In the hygienic exhibition at Rome, Catalano of Tunis exhibited an "Indestructible Sarcophagus," having, according to the patentee, the following advantages:

"The S. CATALANO'S indestructible sarcophagus (Patented) is recommandable for his property of priservation for the mortal boody, as also every documents, insignia, etc.

"It is of very moderate price. this conveyans is easy, with this mode of supultur the buring is facultative, no disengagent of gaz being not to fear, at last, this sarcophagus can be established according the desir of the family and drawings, with or without ornements, etc.

HYGIENIC KANDAKO.

"This kandako with hermetic and automatic closing prevent every disengagement of deleterious gaz who difile to often the atmosphera of the great centre of population. It is of easy application, this system is completed with a conduit managed for the burning of disinfectants as brimstone, whom the vapour will distroy every germs living, prejudicial to the public health.

"Indirizzo: SALVATORE CATALANO DI FRANCESCO, 35, Rue El-Meklar, TUNISI."

THE CART BEFORE THE HORSE.[1]

By BENJAMIN LEE, A. M., M. D., Ph. D.,

Secretary of the State Board of Health of Pennsylvania.

When those who speak the English language desire to characterize a line of thought or of procedure as being in the very highest degree ridiculous and absurd, they make use of the word "preposterous," a word which they have had handed down to them from the days of ancient Rome; for the Roman with his strictly logical mind could conceive of nothing more grotesque and idiotic than placing that which should properly and reasonably be *pre—before*, whether in relative position or in sequence of time, *postera*, *behind* or *after*. The Saxon, with his love for the concrete and his fondness for epigram, crystalized the thought into the proverbial expression, "The cart before the horse." I know of no more forcible exemplification of this trite but useful old adage than the absolute reversal which we so constantly find of the appropriate relative positions in point of time of the introduction of water supplies and the provision of systems of drainage. There were three things which were too wonderful for Solomon, yea four which he knew not: "The way of an eagle in the air, the way of a serpent upon a rock, the way of a ship in the midst of the sea, and the way of a man with a maid." Had the wise man lived in our day he would have been tempted to add a fifth cause of wonderment: the way of a "practical plumber" with the drainage of a house. "Sanitary Plumbing, a Specialty," How often does that sign meet the eye! And what is the conception of the practical plumber who puts it over his door of sanitary plumbing?

Let him be among the most honest and intelligent of his craft, and what thought has he beyond making tight joints and secure traps, and thus preventing the gases of decomposition and putrefaction from finding their way back into the building for which he is providing the water supply, through the lines of his own pipes? How much thought does he give to the ultimate destination of the filth-laden torrents which are discharged from those pipes? "All the Modern Improvements." How attractive this announcement looks in the advertisements of suburban residences! And how charming the bath-room appliances appear to the seeker for a healthful home for himself and his little family not too far from his place of business. The glittering faucets, the shining tubs and the porcelain receivers, the *dulce-domums* the *dececos*, the cataracts and all the other variations of the common receptacle. The first thought of the citizen who proposes to build himself a country residence is beauty of location. The second, architectural adornment. The third, possibly, a copious and pure water supply, and with this, modern plumbing follows of course, as

[1] Read at the Montreal meeting of the American Public Health Association.

a necessary accompaniment. Last of all, he or his architect bethinks himself that it will be necessary to find a receptacle for this little stream which he is going to divert from its natural course and fill with the accumulated filth of his household. That which should have been most carefully considered first, before a line was drawn or a plan designed is left to be provided last in some hap-hazard way, as if it were a trifling detail of no moment whatever. The problem may prove impossible of satisfactory solution to himself. Or if provision can be made in such a way as to relieve himself of annoyance, the chances are ten to one that his neighbor will begin to complain of the flooding of his yard or the pollution of his well; or, what is still worse, and unfortunately of undoubtedly frequent occurrence, sickness may be created in families more remote, the cause of which is unsuspected and therefore unremoved.

As an example out of many which I could cite, the following has recently occurred in my own experience: In one of the most beautiful of the suburbs of Philadelphia resided a gentleman whose business took him to the city every day. The situation of his house was delightful, the drainage of the neighborhood good, the water pure. Every prospect pleased, and only man was vile. Next to his place and on higher ground was a comfortable family mansion on a comparatively small plot of ground. The owner of this mansion saw an opportunity for turning it to profitable account by renting it as a summer boarding house. Its situation was attractive, and the old house was soon crowded to overflowing. It was therefore enlarged until it had a capacity for about seventy guests. The old water supply became insufficient and a new one was introduced affording a flow of two thousand gallons a day. And now came trouble. There was no proper provision for this flood. French drains were dug all over the little lot, but they were insufficient to carry it off. Flowing into the public road in front of our friend's house and even on to his property, it quickly constituted a nuisance of a very serious character. The state board of health was appealed to, and, as the neighborhood, although quite populous, was without incorporated rights or local health authorities, considered it to be its duty to interfere. The effluent was carried under the surface to an old sewer at a distance and the trouble temporarily remedied, although by no means satisfactorily and permanently. But now comes a curious part of the story. The engineer inspector did not consider his full duty performed until he had also examined the drainage on the property of the complainant. This gentleman had prided himself on the perfection of his "sanitary" arrangements, and yet all of his drainage was received into a leaching cesspool which was close to the house and evidently constituted a serious menace to the health of his own family.

The little towns among the hills and mountains of Pennsylvania are peculiarly fortunately situated for the introduction of an abundance of pure water. The municipal authorities of these towns are besieged by water supply contractors, generally from New England, and there-

fore having no local interests in the towns, with offers to introduce water on very advantageous terms. The temptation is great and is often yielded to before a single rod of sewer pipe is laid in the streets. Then the "practical" and "sanitary" plumber get in their fine work. Every ambitious citizen must have water all over his house, with all the modern appliances. The kitchen water even though in greatly increased quantity may pass off over the surface and through the street gutters. But what shall be done with that discharged from the water closets? Happy thought! He no longer depends on the old family well for drinking water, so into that the soil pipe is incontinently discharged. So far so good. It does not annoy him. But he does not reflect that the same subterranean stream which supplies his well in all probability supplies those of the entire neighborhood. It can be readily understood how that which should have proved to be an inestimable blessing to the community may thus inadvertently be converted into a terrible calamity. Even in gravelly soils, where opportunity for filtration to a considerable degree exists between neighboring wells, this danger is a most serious one. It will easily be seen how much it is aggravated in limestone regions where the water courses along underground for great distances, almost unobstructed. And yet it is just under these circumstances that the temptation to avail one's self of this so called natural drainage is the greatest. The object of this paper may be briefly embodied in the two following propositions:

First. Copious water supplies, with the aid of what is known as modern plumbing, constitute a means of distributing fecal pollution over immense areas, through the soil, through subterranean water-courses, and in surface streams, and cannot therefore be regarded with unmixed approbation by the sanitarian.

Second. The question of drainage and sewerage whether for individual residences or for communities should always precede that of water supply, and no water-closet should ever be allowed to be constructed until provision has been made for the disposition of its effluent in such a manner that it shall not constitute a nuisance prejudicial to the public health.

A FEW OBSERVATIONS UPON SEDIMENTATION IN WATER.[1]

By WYATT JOHNSTON, M. D.,

Lecturer in Bacteriology, McGill University, Bacteriologist to the Quebec Provincial Board of Health, Montreal, Canada.

The results recorded here were incidentally observed during a biological analysis of the Montreal water-supply, made in 1891. They are of interest chiefly from the fact that they concern the water of two large rivers—the Ottawa and the St. Lawrence—which have been very little studied.

As is well known, fairly large masses of water become, upon standing, considerably improved in quality, and in particular become relatively free from bacteria. This reduction in the number of bacteria from sedimentation, while far below that effected by sand filtration, is still sufficient to be of importance from a sanitary point of view; especially if owing to local condition, such as low winter temperature, unusual difficulties exist with regard to introducing filtration.

The improvement from sedimentation, like that from filtration, is more marked in impure than in clear waters, and is greater when the suspended matter is dense than when it is light and flocculent. The improvement also depends to a certain extent upon the capacity of the water for keeping well when stored.

We are justified in assuming that although the danger from a sanitary point of view may not increase directly with the number of bacteria in a drinking-water, yet that the fewer bacteria in a water-supply the better are the prospects for the health of those drinking it.

In connection with my bacterial study of the Montreal water-supply, it is interesting to note the relative number of bacteria in the reservoir as compared with that in the aqueduct leading from the intake. At the foot of the aqueduct, near the pumping-station, is a pond about fifteen feet deep, called the Settling Basin. This contains twenty-three million millions gallons of water. Now as the daily consumption of the city of Montreal is about eighteen million gallons, and also during the greater part of the year about double that amount of water is daily drawn from the settling basin to supply motive power to several large turbines used for pumping, it is evident that the conditions are very unfavorable for sedimentation.

On August 7 and September 12, I made comparative estimations of the number of bacteria in the river water at head of the intake near Lachine, and that of the settling basin, with the result that the water in the basin contained in an average 168 bacteria per c. c. by the gelatine method, while that at the intake had contained only 84 per c. c., showing that the river water had perhaps slightly deteriorated in quality during its

[1] Read at the Montreal meeting of the American Public Health Association.

passage along the aqueduct, a narrow canal with earth banks, and that this had not been rectified by any slight settling it had received at the basin, though the difference was too slight to be of much significance.

The lower level reservoir has a capacity of 35 million gallons, and is not furnished with separate inlet and outlet pipes. From it a large amount is daily pumped on upper level reservoir, and during about four hours daily it supplies water to the city mains. I have been informed by the officials that in this way about 20 to 25 per cent. of the water is daily replaced by fresh water, but do not think the change is as great as that. In any case the conditions for sedimentation are much more favorable than those in the so-called settling basin.

The results of bacteriological examinations extending over eleven months were as follows:

BACTERIA PER C. C.

Month.	Settling Basin.	Reservoir.
December,	313	87
January,	44	31
February,	89	20
March,	164	185
April,	347	171
May,	121	79
June,	169	42
July,	481	31
August,	119	92
September,	89	21
October,	51	40
Average,	178	72

The average number of bacteria in reservoir water was thus only 42 per cent. of that from the basin.

The fact that in March the number in the reservoir was slightly higher than in the basin is apparently due to the fact, established by another information, of a transient pollution of the water due to a thaw, had caused a rise in the number present in the river which had disappeared by the date of examination, as the reservoir water does not represent that from the aqueduct on the same day but that of a few days previous. For similar reasons I have left out the observations made in November, when the settling basin water contained 1,332 bacteria per c. c., and the reservoir water only 143 per c. c., as this difference appears too great to be due to sedimentation, and is probably due to the fact that but little of the polluted water had entered at the time.

In the months of July and September I made two sets of observations of the water of the St. Lawrence and Ottawa rivers above Montreal, taking the samples by means of a fishing-rod and line a few feet below the surface from the bow of a steamboat. The results show that in these rivers the number of bacteria varies inversely with the rapidity of the current.

For the St. Lawrence the number of bacteria per c. c., near the foot of

Lake Ontario, was from 20 to 50, and this number was maintained to the Galop rapids below Prescott. From this point to Cornwall, the number rose from 60 to 70 in September and from 100 to 200 in July, falling again in Lake St. Louis to 12 in September and 47 in July.

In the case of the Ottawa river these variations were more strikingly shown, and the pollution of the water by the city sewage of Ottawa was evident in spite of the large volume (60,000 cubic feet per second) of the river.

A few miles above Ottawa, where the river expands into a small lake—Lake Des Chênes—the average number of bacteria per c. c., was found to be 20. In the river, between the lake and above the city of Ottawa, this number rose to 157. Some miles below Ottawa the number rose to 1,530 on one occasion and 520 on another (the points where the maximum pollution was met with not being identical, however.)

This increase in bacteria gradually subsided, and at fifty miles below Ottawa, the number had fallen to 48 in the first observation and 40 in the second. In the lake of Two Mountains, at St. Anne, the number sank to an average of 11 per c. c. in July and 7 per c. c. in September, many of the culture plates being completely sterile. It is thus evident that any sewage bacteria which enter the river at Ottawa are effectually got rid of long before the water reaches Montreal.

Exactly what takes place in water undergoing sedimentation is not very clear. That the bacteria do not simply settle to the bottom is evident from the fact that in the lower strata their number is not materially higher than at the surface. In support of this, I may instance four observations:

BACTERIA PER C. C.

	Near Surface.	Near Bottom,	Depth.
No. 564 Reservoir,	54	67	25 ft.
No. 564 A Reservoir,	16	17	25 ft.
No. 570 Reservoir,	203	208	25 ft.
No. 555, Lake St. John,	24	17	45 ft.

In addition, the motile as well as the non-motile bacteria disappear in sedimentation.

The theory, advanced by Buchner and accepted by P. Frankland, that sunlight is the chief agency in causing this decrease does not appear tenable in the case of the Ottawa water which is very opaque and contains a large amount of peaty pigment.

As to the hygienic value of sedimentation as a means of removing bacteria, it evidently ranks far below sand filtration, which removes from 97 to 99 per cent. of the bacteria and therefore filtration is practically to be preferred. Chemical precipitation by alum, etc., has not as far as I know been successfully applied on a very large scale to drinking-water.

In the case of Montreal, however, the extreme cold during the winter makes it difficult to see how filtration can be successfully carried out without enormous expense, as open filters would certainly freeze solid.

As this is a matter which cannot be decided upon theoretical ground, it would be well to make experiments on a small scale to see whether filtration is practicable, and if this is not found to be the case, then to determine what amount of settling area is needed to obtain the maximum purification of water obtainable by this means.

THE LONG ISLAND WATER BASIN—BROOKLYN'S RESERVOIR.[1]

By A. N. BELL, A. M., M. D., of Brooklyn, N. Y.

Long Island lies between Long Island sound and the Atlantic ocean, north and south. Its length from the western end, washed by the East river and the Upper Bay of New York, to Montauk Point, its eastern extremity, is 118½ statute miles; and its greatest breadth 23 statute miles. But there are numerous coves and small bays on both sides which in several places leave less than half its greatest breadth between, insomuch that its average breadth is about seventeen miles.

A ridge of hills, beginning with the site of Fort Hamilton at the Narrows, comprising Bay Ridge, Brooklyn Heights, and continuously other hills of various altitude, extends all the way along the north side to Montauk. This ridge is commonly called the "backbone" of the island. The hills are almost wholly covered with luxuriant vegetation, or fruitful crops seasonably, as are also the valleys between. The highest of them, Hempstead Harbor Hill, at Roslyn, is 384 feet above sea level. Two or three others are nearly as high, and the terminal one at Montauk is 194 feet above the ocean. From the centre of this ridge—varying in distance from 100 rods or so to two or three miles from the north shore—the surface descends southward, about 20 feet to the mile on the whole, but with some remarkable peculiarities. There are numerous narrow depressions, all taking their rise in the hills and extending southward, appearing very much like the dry beds of once flowing streams. With rare exceptions they are never flooded, because the porosity of the soil is such as to rapidly take up all the rainfall. These depressions become more and more shallow and broader as they descend, until they are finally lost within a mile or two of the south shore, in the general expanse of an almost level plain. Along the margins of these otherwise dry beds, and at many places in the sandy plain where all traces of them are lost, there are outbreaks of water—not springs—from the surcharged subsoil; but from these outbreaks rise many beautiful rills, some of which swell into brooks of considerable size, all running toward the ocean.

Equally remarkable is the number of basin-like dales scattered here and there all over the island. Many of them hold water all the year round, and some of these are pretty lakelets, of a mile square or more. These ponds have no outlets except the overflow into the sandy soil by which they are bound, and over which they never flow. The depth of some of them extends to the full depth of the level of the soil saturation, and these consequently are never empty. The water they contain, the

[1]Read at the Montreal Meeting of the American Public Health Association.

same as that which breaks out in many places on the plain, is remarkable for its purity.

The structure of Long Island is boulder and boulder drift ground to gravel and sand by waves of the ocean during the period of coast subsidence. These sands rest upon an impervious stratum of hard pan, or blue clay, of variable depth; from within a few feet of the surface in some places—which places are on that account unhealthful—to more than seventy feet in others, but with an average depth through the central portion of the island, of about fifty feet, and throughout, even in the dryest weather, they are loaded with pure water to within twenty-five feet of the surface—a vast sand-filtering reservoir surpassing any which human ingenuity has ever contrived.

In the experimental and subsequent progress of the work for procuring the water supply of Garden City, twelve to fifteen years ago, which fell under my personal observation, there was not a single particle of decayed or decaying organic matter of any kind discovered in the soil.

Garden City is situated at an elevation of 103 feet above sea level, about midway between the shores of the Atlantic ocean and Long Island sound, 20 miles eastward from Brooklyn. The soil was found to be in layers, the beds having a dip southward. The depth of the subsoil at that place was 70 feet, but from experiments round about it is supposed to be much greater in some places. By boring through the gravels and sand at the depth of 70 feet, a dense crust of hard pan was encountered. Six miles nearer the ocean the depth of sand and gravel was found to be 68 feet, resting upon a bed of blue clay. This underlying layer of hard pan, or blue clay, beginning in the hills, extends not only quite to the south shore, but doubtless at some distance under the ocean beach beyond. Wells sunk sufficiently deep into this soil are of exceptional purity and inexhaustible.

The well at Garden City is 50 feet in diameter, the surface of the water in it is 25 feet below the general level of the plain at the place where it is located—in one of the river-bed like depressions, 14 feet below the general surface, so that the depth of the well to the surface of the water is only 11 feet. The depth of the water is 20 feet, and rises from the bottom. No water gets in through the sides of the well, because they are thoroughly impervious. The enormous volume and pressure of the water into which it is sunk will be appreciated from the fact, that while it was in process of construction four wrecking pumps, discharging through pipes 10 inches in diameter, were worked continuously day and night for a whole week, in order to keep the water sufficiently low to proceed with the wall. The water from this well is distributed by means of a Holly pump, adequate to discharge of 3,000,000 gallons daily, and the supply is abundant.

At East Rockaway there is another well, similar to the one at Garden City, only about 10 feet above the tide level of the salt creek and marsh 20 rods distant, which, by means of a pump and pipe, supplies water to

Long Beach. It is sunk from the surface level to the depth of 20 feet only, and is 38 feet in diameter. The average daily delivery is 200,000 gallons; 500,000 gallons could be supplied if necessary without any danger of exhaustion. The depth of water in it has never been known to be less than six feet.

From the fact that the level or soil saturation, as discovered at Garden City, in the central portion of the island, is many feet above tide water, there occurs a ceaseless flow of the subsoil water from the "backbone" toward the sea-shore; not in the form of a subterranean stream or river, but in entire mass, filtering through gravel and sand slow, indeed, but persistent—found by actual observations over a wide area to move at the rate of from 8 to 12 feet daily.

The annual average rainfall over Long Island is 43 inches. It has been estimated that three-fourths of this sinks into the soil. The surface waste is very small; indeed, there is scarcely any, except in winter when and where the ground is frozen. It is certain, therefore, that the entire volume of the rainfall, excepting this small waste in the winter time and that which is lifted by evaporation or absorbed by vegetation, is carried by the soil.

Forty-three inches of rainfall is more than three and a half cubic feet upon a square foot of surface. For convenience of calculation, let us assume that three feet sinks into the soil. This would give more than 83,000,000 of cubic feet to the square mile, or 2,500,000 tons. A freight car will carry 10 tons. Two hundred and fifty thousand cars, therefore, would be required to convey the rainfall upon one square mile in a year.

The whole surface area is about 2,000 square miles. One half of this area, at least, would fall within the most favorable conditions described. It is quite safe, therefore, to estimate the size of this reservoir to be 1,000 square miles, with an average depth of 50 feet. This is Brooklyn's reservoir—the primary source of her water supply. The "ponds" are intermediary, mere convenient receptacles.

While the waste of streams is enormous, it is nevertheless easy to appreciate from a knowledge of the conditions of the soil and the examples cited of the wells sunk into it, the inexhaustible adequacy of the Long Island water basin to supply water sufficient to meet the demands of Brooklyn for all time, and the folly of those who would in the face of such knowledge seek it elsewhere.

THE WELL WATERS OF OUR FARM HOMESTEADS.[1]

By FRANK T. SHUTT, M. A., F. I. C., F. C. S.,
Chief Chemist of the Dominion Experimental Farms, Ottawa, Canada.

The knowledge of the fact that pure water is indispensable for the preservation of good health, is now public property—thanks to the medical profession, our school text-books on hygiene, and the press. The converse, viz.: that polluted water is the cause of much sickness and enfeebled health, is also generally recognized as an axiom. Notwithstanding, we find many intelligent and thoughtful people totally, and I may say, criminally, disregarding this matter of vital importance to themselves and their families. The number of people who still neglect to take, what we might term, a common-sense view of this important question, and who fail to recognize and realize polluted water as a source of imminent risk to health, is, I am afraid, very large.

During the past six years the Chemical Department of the Dominion Experimental Farms has examined some hundreds of samples of water from wells on Canadian farms. As a result of this work—the details of which may be found in my annual reports to the Department of Agriculture—the fact has been impressed upon the writer that the evil of polluted water is a lamentably common one throughout our country districts, both in the villages and on the farms. It is because of the well-nigh universal apathy on this subject exhibited by the members of our rural population that, being honored with an invitation to present a paper to this convention, I have selected as the theme for my remarks: "The Well Waters of our Farm Homesteads"; trusting that the publicity of the proceedings of this meeting may awaken our farmers to a deeper sense of the danger that exists in using a polluted water and also caution them as to the great care necessary in the selection of a site for their water supply and the prevention of the latter from subsequent contamination.

I shall not, on the present occasion, bring forward chemical data to indicate the character and extent of the pollution, nor shall I cite details to show that many cases of typhoid, diphtheria, and other zymotic diseases, have been directly traced to the use of a polluted water supply. Abundant evidence of this character can be furnished by every physician and water analyst. Sanitarians, the world over, supported by chemists and bacteriologists, hold that impure water is the chief means by which the germs of many epidemic diseases are conveyed through a community. It would be an easy matter to relate a number of instances from my own experience, where deaths have occurred from typhoid fever and diphtheria, and the water on analysis has been found to be seriously contaminated with drainage or soakage of a pernicious character. In extreme

[1]Read at the Montreal meeting of the American Public Health Association.

cases, such as these, no doubt the truth often forces itself home, but not before the fatality, has the farmer deemed it expedient to have the water examined. Forewarned is forearmed, and a dissemination of knowledge on this matter will, I trust, have the effect of lessening the number of such sad instances. Serious as such results are, I would, however, lay particular emphasis upon what appears to me as a still more injurious, because more generally and more frequently overlooked, feature of water polluted with excrementitious matter—I refer to its insidious action upon the general health. There can be but little doubt in the minds of those who have had the opportunity of studying the subject, that water containing the drainage of the barnyard or privy is often the cause of many intestinal disorders. Diarrhœa and indigestion in one or other of its forms may, in many cases, be attributed to its action. I admit that we can, to a certain extent, habituate ourselves to the use of bad water, and that naturally there is a tendency in the animal system to overcome its effects, but we cannot overlook the inevitable result that such eventually ends in impaired state of health, lessening of the bodily vigor, and a making-ready of the system for the inroads of still more serious diseases. To preserve robust health and a sound constitution, it is all important that we use uncontaminated water. We are all pretty well agreed as to the communicableness of zymotic diseases through the use of water which has received the excreta and dejecta of patients suffering from these diseases, but the exact physiological effects of water polluted with decayed matter of animal origin, apart from the action of pathogenic germs that may be present, are not, as yet, well known. Such decomposing animal matter is rich in nitrogen, and, therefore, particularly susceptible to change. It seems to me very probable that toxic compounds, akin to the ptomaines or cadaveric alkaloids, may in this way be formed (perhaps without the aid of bacteria) and the water thereby rendered dangerous to health. There certainly seems a good deal of evidence to support this suggestion. The purest, most wholesome waters are those most free from organic matter, especially from that of an excrementitious origin. This is a fact that has received corroboration from all sanitarians; for apart from the already expressed opinion as to the danger that may exist from the formation of noxious compounds, such organic matter is the best pabulum for the growth and development of disease germs, should they find their way into the water.

It indeed seems a little strange that it should be necessary to preach the doctrine of pure water to our rural population, but such, nevertheless, is the case. The purest water, undoubtedly, is to be found in the country, for it is there that the natural conditions prevail for its occurence; yet owing to apathy or ignorance, our farmers and villagers are, as a rule, worse off respecting this blessing than those living in the cities. This may be acounted for in part, no doubt, by the fact that every man in the country has the making of his own water supply and the keeping of it pure.

The Dominion of Canada is an exceedingly healthy country and its air

and water are of the purest. In all parts, with the exception of those restricted areas impregnated with alkaline salts, and where droughts occur at times, an abundance of pure water prevails at all seasons. There should be but little difficulty on the greater number of our farms in obtaining an unpolluted supply, but, to quote what I have stated on a former occasion, " farm wells are often, for convenience sake, sunk in the barnyard, the stable, or kitchen." If not in one or the other of these places, we frequently find them situated dangerously near the privy, pig pen, or other polluting sources. If any drainage system is in force it is defective, or at the best but partially effective. Too often we find no precaution whatever taken against drainage from the kitchen, and household slops find a temporary resting place on the ground close to the house, and perhaps near the well. The natural result of this condition of affairs is that much excrementitious and waste matter finds its way into the well. Repeatedly I have found the farm well acting in the capacity of a cess-pit and its water, without exaggeration, to be a dilute form of liquid manure.

The only method that I know of for lessening this evil is by instruction and advice.

First: We must emphasize the great danger that lies in using water polluted with excreta or drainage from filth sources. Our people must be taught that not only are the more serious of the germ diseases directly communicated in this way, but that the general health is often affected. That intestinal disorders are brought on, and that sooner or later dire consequences will fall upon them or their children by the continued use of a contaminated supply.

Second: We must teach that pure water is as much a necessity for the farm animals as for man. Unless the stock is in good health it cannot thrive properly or profitably, and good health does not follow the use of polluted water. To dairymen and milkmen pure water is, of course, an absolute essential. The wholesomeness of milk and its various products is, to a large extent, directly dependent upon the character of the water used by the cows, and in the manufacture of butter and cheese.

Third: Farmers must be cautioned against sinking wells in barnyards and stables or near the pig pen or privy. In such places it is only a matter of time before they begin to act as cess-pits. In light, sandy soil drainage travels long distances, more especially where the superficial soil lies, at no great depth, on a bed of clay, and there is the inducing element of a well in the neighborhood. Clay soils are certainly more or less impervious, but these, in such places as I have mentioned, in time become saturated with filth, and pollute the water which passes through them.

Fourth: Having the well suitably located (and some acquaintance with the character and dip of the strata in the neighborhood, will assist in selecting a safe site) care should be taken to preserve the precincts free from all accumulated filth. Periodically all wells should be examined and cleaned, for, besides ordinary *debris*, the bodies of drowned mice, rats, and other small animals are often to be found therein.

Fifth: Since a proper system of drainage to our barns and stables is for the most part prohibited by our rigorous climate in winter, the liberal use of absorbents to take up as formed the liquid manure, is strongly recommended. The value of ground gypsum (plaster) for this purpose is, or should be, well known. It fixes and retains in a non-volatile form the ammonia as it is produced by the fermentation of the urea and at the same time adds to the manure heap plant food particularly suitable to certain farm crops. A cheap, effective, and valuable absorbent and deodorizer is found in air dried swamp muck and peat. Vast deposits of these materials are to be found in many districts. These absorbents can hold as much as four hundred times their weight of water or liquid manure. They contain much plant food, especially nitrogen, which, by this method of composting, is rendered soluble and available. Experience has shown that an exceedingly valuable manure results from its use. From a plentiful application in the barnyard, pig pen, and other places where there is fluid excreta to absorb, much fertilizing material can be preserved that would otherwise be wasted. From a hygienic standpoint it is exceedingly valuable, for it keeps farm buildings and their surroundings clean and healthy.

I feel that I should, in closing this paper, make a brief reference to the efficiency of the so-called tests in diagnosing a water. I am aware that many are of the opinion that reliance may be placed on the results of a qualitative examination by means of the sugar test—nitrate of silver and permanganate of potash—used alone or in conjunction. My experience leads me to believe that such results are frequently misleading.

The amount of precipitate by nitrate of silver when the reagent is used qualitatively can only be conjectured, and from it no correct inference can be drawn unless something is known of the strata of the district and the amount of free ammonia that accompanies it.

The decolorization of permanganate of potash is still more fallacious. Peaty and upland waters will discharge the color from a comparatively large quantity of permanganate of potash, while we often find very little of this salt required by water reeking with the decomposing products of excreta.

The color and appearance of a water cannot be relied upon as indicating the purity or impurity of a sample. Many waters have no marked odor, that prove on examination to be seriously contaminated. A water may be colorless, bright and sparkling, and yet dangerously polluted, while on the other hand, dissolved peaty matter of a comparatively harmless nature, may tinge a water with a suspicious yellow color.

There are, I believe, but few cases (and those of very bad and very good waters) where complete analysis is not necessary to a correct diagnosis. In our laboratory we always determine the following chemical data:—free ammonia, albuminoid ammonia, nitrogen in nitrates and nitrites, chlorine, total solids at 105° C., oxygen absorbed at 80° F. from permanganate of potash in fifteen minutes and in four hours, and phosphoric acid (qualitative). The results are returned in parts per million.

All farmers wishing an examination of their well waters are furnished with a copy of instructions for collecting and shipping the sample, and emphasis is laid upon the necessity of supplying full information respecting the well and its environments.

In this cursory review I have not been able, for want of space, to treat this subject with the thoroughness its importance merits, nor has it been possible to even mention many points of great interest. The relative value of chemical analysis and bacteriological examination, the weight to be placed upon certain chemical determinations (such as the nitrogen in nitrates and nitrites) and the establishment of American standards of purity, are all questions of scientific and technical interest which might be discussed with profit. All that I have endeavored to do in this short paper is to direct attention to the fact that much impure water is consumed in the country, with serious and often fatal results, and to point out the principal lines upon which I think a reform may be brought about.

As the agriculturists form a very large proportion of the population, I think it well that we who take an active interest in the health of our people should endeavor to disseminate through the country knowledge regarding the injurious effects of impure water, and the precaution necessary to be observed if pollution of the well is to be prevented. I have no doubt that one of the beneficial results of this convention will be a keener and better, and more intelligent understanding of this vital subject—an understanding that will lead to purer water and better health upon our farm homesteads.

PURE WATER VS. PURIFIED WATER FOR PUBLIC WATER SUPPLIES.[1]

By DANIEL W. MEAD, Rockford, Ill.

The sanitary value of a source of water supply depends not only on its present condition, but also on the possibility of its future pollution. It has become painfully obvious that civilization is its own worst enemy; that the greatest loss of life and health is through that class of organic poisons which, reproducing themselves in the human body, are discharged through the various waste secretions of the system, and unless utterly destroyed, are capable of reproducing their characteristic symptoms in the systems of other persons in whom they may have, through air, food, or drink, become accidentally lodged. The village cesspools have hence become foci of contagion through infiltration into the village wells which has often caused epidemics of contagious diseases, more or less extended, according to the amount of use to which the wells have been put.

With the experience of time and the concentration of inhabitants, this fact has become so well appreciated that the construction of public water supplies and sewerage systems has become quite common in the larger communities.

The fallacy of the immediate and rapid self-purification of running water, no matter how badly polluted, is now quite well understood, yet the disposal of sewerage by means of water-ways, and the utilization of such water-ways for public water supplies, is yet so common as to seriously menace public health in various communities and undoubtedly is the direct cause of much sickness and loss of health and life.

Surface supplies, if derived from areas sparsely populated and free from dense forests and large swamp areas, may furnish an unobjectionable water. An increase in population may, however, become a fatal defect, and even a limited population demands sanitary supervision and stringent regulation; eternal vigilance being the price of safety. In such cases the supply is unobjectionable for present use, but at any time, through the normal growth of population or from accidental causes, its condition may radically change.

The restriction of pollution by sanitary inspection or the clarification of river or other surface waters by various means has been widely attempted and with undoubtedly beneficial results. Both, however, depend on the vigilance of those employed to attend to them, and, as human agencies are fallible, sometimes with disastrous results. Sanitary inspection depends on the keenness and carefulness of the inspector, while clarification depends on the adaptation of the special means to

[1]Read at the Montreal meeting of the American Public Health Association.

certain conditions, more or less changeable, to attain certain ends; and during epidemics great responsibilities are thus placed on those attending to these duties. A single mistake in judgment or relapse in vigilance may precipitate an epidemic with more terrible results than would happen through a misplaced railway switch.

It is highly desirable to avoid the necessity of fallible agencies wherever possible, and adopt the infallible where such can be secured by careful study and at a reasonable expense.

In the human mind the best results are obtained by concentration rather than by continuous effort. Hence we may plan to better advantage for the utilization of sources which need expert knowledge and correct construction at the outset for their maximum and continuous efficiency rather than those which need continuous exertion and unrelaxed vigilance to accomplish these results. These are not simply theoretical deductions, but are facts, the importance of which have been verified by heavy losses in life and property due to a relaxation of vigilance under critical circumstances of time and condition.

It is then apparent that the securing of unpolluted supplies rather than the clarification of those already polluted will attain the surest results, and if a supply is obtainable which cannot be polluted, it is evidently much more desirable than one which may be polluted if improperly policed or which needs clarification. In the former case vigilance may relax; in the latter case, in certain emergencies, only a few feet of filtering material or other medii, used to effect similar results, and the watchfulness of muncipal employés stand between the people and epidemic diseases. The efficiency of various methods for accomplishing the desired results of clarification is fast being demonstrated satisfactorily and clearly, but the further investigation proceeds the more clearly it is defined that the circumstances never being exactly the same, the results obtained are apt to vary widely. The nature of these results depends on the intelligence used in the adaptation of means to accomplish the desired ends under the prevailing conditions. The variation in results is not due so much to the failure of our understanding to group the necessities of the case, as to the lack of ability to carry them out to the extent required. Filtration, for example, if carried to a proper extent with properly and thoroughly constructed filter beds, under proper management and of sufficient capacity for the work required of them, could be made infallible in their action under ordinary circumstances. Yet on actual constructions it is found necessary, on account of financial reasons, often to keep dangerously near the limits of safety; so near, in fact, that such limits are frequently passed and the results attained are failure, perhaps at a most critical time, when life and health hang in the balance. If then the greater resources of nature can be utilized, we may attain results not attainable through artificial devices ordinarily within our reach. The vast geological strata which underlie the country, thousands of feet in thickness, frequently offer filtering medii so extended as to purify

water in a sanitary sense beyond question. Such sources, where they can be utilized for water supplies, are ideal ones, and fortunately their occurrence is much more extended than is commonly supposed. The upper Mississippi valley has many examples of such supplies; notable at Rockford and Aurora, Ills., Dubuque and Clinton, Ia., Mankato, Minn., and Madison, Janesville, and Fond du Lac, Wis., together with many smaller places and numerous private supplies offer examples of what may be done in this area in the utilization of supplies which, if properly developed, are beyond possibility of pollution. The whole upper Mississippi valley is underlaid with the pervious Potsdam and St. Peter sandstones which, coming to the surface in extended out-crops in the higher parts of Wisconsin, receive the rain and drainage waters of streams into their pervious structure and transmit it often through miles of sandstone, which effectually filters it, to all points within the valley where it is required for public supplies. Sometimes the relative elevations of out-crop and point of utilization are such that flowing wells are obtainable, but at all points the waters may at least be raised by mechanical means, and when so obtained furnish a supply absolutely free from all dangers of contamination from the zymotic diseases which are usually spread through the pollution of water supplies. It is to be noted that precautions are necessary to receive, store, and distribute the waters thus obtained, but intelligent designs will make them absolutely safe without further inspection or vigilance. Almost the whole United States costal slope of the Atlantic ocean presents similar sources in the cretaceous strata, which are widely utilized, but not as widely as sanitary quality will warrant. The same character of supplies is utilized at Memphis, Tenn., and Savannah, Ga., and the artesian basins of the Dakotas, Colorado, Texas, and California are fast becoming known and will in time become more generally appreciated.

Unfortunately waters from these sources are sometimes so highly mineralized as to be unsuitable for domestic and manufacturing uses in their natural state. Such waters may be sometimes softened to advantage. The softening processes may often be more uniformly accomplished than clarification, and any variations in results, while they may give rise to unpleasant conditions, do not give rise to unsanitary conditions as in the variation in clarification. Purification through natural filtration is on such a vast plan that with favorable conditions almost any amount of water can often be obtained from the strata without any injury to their efficiency. At the same time, if properly selected and with works properly designed such sources offer a permanent security from the most dreaded diseases which all too frequently sweep through many of our municipalities.

The importance of a proper selection of sources of public supplies cannot be overrated, and this importance should be made apparent to the public mind, which will regard the points here presented simply in the abstract without attempting their practical utilization. Too often a few

dollars stand in the way of safety and permanent security. Too often the self-styled "practical man" secures the adoption of his ideas, which includes the most obvious and cheapest surface or shallow sub-surface supply, which is consequently the most liable to pollution. The advice of the sanitarian or sanitary engineer, which would often entirely prevent the possibility of epidemic visitation, often sounds on unheeding ears. Such services are wanted to effect a cure when the dread danger is at hand, not when it is only a remote possibility.

The results are too important, however, to be lightly passed, and by those in authority as local sanitary officers, the presentation of the gospel of good health and security through the correct planning and construction of public works is a most important duty.

WATER SUPPLY FOR TOWNS.[1]

By A. P. REID, M. D.,

Secretary of the Provincial Board of Health of Nova Scotia.

This subject presents itself under different heads,—

1. For domestic and culinary purposes.
2. For supply of factories and steam-boilers.
3. Removal of sewage, etc.

Sources of Supply.—Wells, lakes, rivers, springs, and stored rain-water. Any of these, if abundant, will serve all purposes except the domestic and culinary, and these require most careful consideration from a sanitary point of view.

Wells.—The most common sources of supply will be satisfactory if they be at a distance from human habitations with their ordinary surroundings or receive their water from a large ground water-supply, but these conditions rarely obtain in towns, and hence are justly regarded with suspicion.

The artesian and "drive" wells, in some countries, prove satisfactory, but the geological formation excludes their use in the greater part of this province.

The older the ordinary or "surface" well is, the more suspicious it is for being at the lowest point, the water gravitates to it and in its course to this point picks up soluble matter and decaying material always present near the domicile, and there are not sufficient facilities for its purification by filtration through the soil, and this the more as the soil is charged with the accumulation of years from the houses and barns in its vicinity. Were the well supplied by an underground stream this objection would not obtain to the same extent, but this is not the rule, and hence sanitarians look on all wells with suspicion.

Some towns are supplied by wells which are constructed at such a distance as to be free from probable contamination, and the water pumped into a reservoir from which the town is supplied.

This system is likely to be more common in the future than it has been, owing to the inability to get surface-water which is not exposed to dangerous contamination.

Lakes.—A lake is a depression of the surface; a basin in which accumulates the rainfall of its drainage area. If this be kept free from contamination, then we have an unexceptionable supply as to quality, and the quantity is an engineering problem we need not at present discuss.

Any community looking towards a lake supply should not only consider the quantity and convenience for distribution, but as well the ownership of the enterage of the lake. They should own the drainage area, to the

[1] Presented at the Montreal meeting of the American Public Health Association.

end that no houses or cultivated fields should be permitted to drain into the water-supply. This is a precaution that has been very generally omitted hitherto, and every succeeding year will render it more troublesome and expensive to control that which could have been readily obtained if duly considered at the time of the purchase.

It has been assumed to be sufficient to own a few feet around the edge of the lake with the expectation that the shores and vicinity would so continue without change, but time negatives these hopes; and settlements gradually spring up and the lake becomes the recipient of the drainage of the houses and as well, the cultivated and manured fields, a pollution which increases from year to year with a probable increase in the future.

Hence, when obtaining a lake for a water-supply, its shores and the shores of its principal tributaries should be so controlled that polluted drainage can be avoided.

Rivers.—Hitherto the volume of water in rivers has been so great, and at their sources the districts so unfitted for settlement, that the small amount of pollution from drainage of fields through which they passed has not been considered a matter of great moment, but this fancied security is yearly becoming less, and in the older settled countries this most difficult problem has been presented,—"How can the rivers be kept free from pollution?" and the solution has not yet been forthcoming. Most countries have laws on their statute books having this object in view, but they are practically inoperative, because fields will be cultivated, and the better the cultivation the more fertilizer is used; also the rain will dissolve and remove soluble material and convey it to the river which drains the locality. Where towns and villages spring up along the borders of a stream the trouble is intensified, and this the more when through manufacturing processes deleterious wastes are thrown into the stream.

These questions do not trouble us very much in this province, as there are no large rivers with their riparian towns, and any community requiring service from any of our rivers can depend on a future probable purity if precautions are taken at the commencement, such as a good sanitary officer or engineer would point out in any given case.

Supply from springs requires the same consideration as that from lakes and rivers.

Rainwater Supply.—It is not likely in this province that any large community will be supplied in this way in so far as culinary requirements are concerned, so that the consideration of this method would more properly belong to the individual rather than town water-supply.

Depurating Process.—The impurities in water are classed under the heads of inorganic and organic substances. The former are not specially prejudicial to health, and potable waters are generally sufficiently purified by sedimentation, which permits the fine clay and grosser impurities to subside.

Organic Impurities.—These contaminations can be disposed of in nature's laboratories, and we may consider the methods,—

1. Vegetation—It has long been known that fish will not thrive in water unless it be continually changed, but it is also common knowledge that if water-plants are kept in the aquarium with the fish the changing of the water is not of so much moment. Hence the parity of reasoning the vegetation in the lakes is beneficial, for the plants take their nourishment from the water and the mud on the bottom, and what they remove we do not want in our drinking-water.

2. Fish—Fish flourish in our lakes, and it can be readily perceived that they act as scavengers for us by removing the organic material on which they live, and which we do not want in our drinking water. Every little while we hear of colonies of eels being removed from the Halifax water-pipes. They entered when so small as to pass through the gratings, and what they lived and throve on we do not want in our drinking-water.

Sunlight and aeration are justly considered active factors in purifying water, but more recent labors of bacteriologists have disclosed a host of agencies that were undreamed of a few years ago. These agencies are so numerous and withal so minute and varied that it has not been possible to name or differentiate them, and they are generally described as so many thousands to the cubic centimetre. It takes 16⅓ c. c. to make a cubic inch, and we can with difficulty conceive how enormous must be the number of organisms that ply their active life in removing impurities from our water; they could not live and flourish in perfectly pure water, and their numbers are in so far a measure of the organic substances on which they thrive; the more organisms the more impurities, and vice versa. We have reason to assume that most of these microbes are friends, and act as scavengers. Now and then a foreign renegade gets into their society in the form of a cholera or typhoid-fever or other "pathogenic" organism, and the whole moral tone of the society is lowered; the water for the time is a mass of corruption that poisons those who use it (except it be boiled for half an hour, which destroys all living organisms). Yet in time our friends the other microbes will get in their work and remove the objectionable ones, for the pathogenics can only thrive at a comparatively high temperature, though their germs are tenacious of life for a length of time at a low temperature.

Filtration.—We have been accustomed to talk very glibly about filtration, without correctly understanding how it acts in regard to water purification, yet we thought we knew all about it. Take a sample of muddy water and pass it through a filter, and see how clear and sparkling the water becomes. How easy to understand how a filter acts. Yet the gross particles removed by the filter from the water are in no way *per se* injurious to health.

Then, is filtration of no service? Well, that depends. From time immemorial it has been known that if impure water passes through the soil its hurtful properties are removed, and this is not measured by its limpidity either before or after. The capacity of the soil, as generally

used, is limited, but it will handle unlimited quantities if sufficient time be given for the filtration (with a well devised filter-bed, according to Dr. Koch, the rapidity of transmission should be under 100 mm., or about 4 inches in 24 hours).

And now as to the Rationale of Filtration.—It has long been known that a chemical analysis of water gave but little information in a sanitary sense. The inorganic substances generally present are not specially injurious. The organic impurities classed as nitrates, free ammonia and albuminoid ammonia were looked on as specially obnoxious, especially the albuminoids, and so they prove to be, as they furnish the pabulum for microbes of different kinds, including the "pathogenics."

Research has shown that the upper layers of the soil, amongst others, contain a series of active and most useful microbes that are named the nitrifying organisms, which convert ammoniacal and albuminoid substances into harmless nitrites and nitrates, in which condition, being very soluble, they can be appropriated by plants. In fact, it is supposed that nitrates are the only form of nitrogen that plants can utilize. Now, it is not difficult to understand in what way filtration may be of service, and why it may fail. If a sewage contaminated water is allowed sufficient time and soil for its percolation its harmful nitrogenized impurities can be converted into nitrates, and an impure be rendered a comparatively passable water, but practically it is very risky to depend on filtration for purification.

1. Owing to the very extended area needed to permit a sufficient slow passage of water where large quantities are demanded, as in town or city service.

2. The expense of renewing filter-beds and removal of gross impurities.

3. The efficient action of the whole surface so that the water passes at a slow rate over the whole active surface equably, so that at no point the passage be too rapid.

The satisfactory action of a filter-bed removes injurious substances by making them innocuous and unsuitable for the growth of microbic life, as shown by the greatly reduced number of organisms to the cubic inch, and though there is reason to assume that it is possible, yet it is improbable that sewage contaminated water can be rendered wholesome. Where there is so much risk to health, and expense as well entailed, there can be no question of the desirability for the exercise of the greatest care in selection of a water-supply so that the probability of impure water be avoided.

With regard to the examination of water, a chemical analysis is but of comparative value from a sanitary point of view. The bacteriologist alone can give the probable condition by making known the number of organisms that flourish in it, which shows in so far a ready soil for the pathological varieties.

This examination, to be of value, must have the sample at once analyzed on its collection, for the lapse of a few hours may give results that

are quite misleading, owing to the changes resulting from these active forms of microbic life.

A chemical analysis that can specify that a given sample has or has not organic animal impurity is of great practical value, because it advises us that the given sample is or is not in a condition to support a host of microscopic organisms that may be poisonous if these organisms come from a case of zymotic disease.

Distribution.—We need not occupy much time on this subject, because the pipes are now made of iron chiefly, and but little lead is used except for short lengths in house distribution.

Continuous service and letting the water run a few minutes before using will avoid any probable metallic contamination.

I must apologize for making this paper so short on a subject of great importance, but discussion may elicit more ideas and be of more value than a longer article.

SOME DEDUCTIONS FROM BACTERIOLOGICAL WORK ON THE WATER OF LAKE ONTARIO.[1]

BY E. B. SHUTTLEWORTH, PHAR. D., F. C. S.,

PROFESSOR OF BACTERIOLOGY, TRINITY MEDICAL COLLEGE, TORONTO, AND BACTERIOLOGIST TO THE TORONTO BOARD OF HEALTH.

Having been for the past two years largely engaged in bacteriological work in connection with the water supply of Toronto, I take this opportunity of presenting a brief summary of the result, together with some deductions, which may be applied to subjects on which additional evidence is required.

The city supply is derived from Lake Ontario, through an intake, located about 220 feet from the shore of the island, which lies southward, in front of the city. The mouth of the intake is 18 feet from the bottom of the water, which is there about 75 feet deep. The supply passes, for a few hundred feet, through a 6-foot steel pipe, and thence through a wooden pipe, to the south shore of the island, where it joins a steel pipe, and is carried a distance of some 6,000 feet across the land. It here reaches Toronto Bay, which at this point is about 4,500 feet wide, and is conveyed by a 3-foot cast iron pipe, and a 4-foot steel pipe, both of which terminate in a pumping well on the city side. The entire length of the conduit is nearly two and a half miles, the connections being made by cribs, fitted with manholes, through which samples of water can be obtained. These cribs mark the extension of the pipes lakewards, as the intake was at intervals of years carried farther out.

The sewage of the city empties into the bay, through which the two pipes cross, and the pumping well is, on one side, only separated from the bay water by a masonry wall, lined with cast iron plates. It will thus be seen that should there be any leak in either of these conduits, or in the connections with the pumping well, or in the well itself, the sewage-laden water would contaminate the supply. The sewage is distributed throughout the bay water, and, thus diluted, ultimately finds an exit by the eastern or western channels, which communicate with the lake at each end of the island, which is over three miles long and extends, in somewhat crescentic form, in front of the city. The distance between the eastern and western channels to the intake is, in both cases, nearly the same—about two and a half miles.

NORMAL BACTERIOLOGICAL CHARACTER OF THE LAKE WATER.

I am, as yet, unable to present any statement as to the character of water taken from a point, say in the middle of the lake, and at a consid-

[1] Read at the Montreal meeting of the American Public Health Association.

erable depth, where shore contamination would be reduced to a minimum. I have, however, obtained samples at a distance of over two miles from the island, or nearly five miles from the mainland. One of these was taken in October, 1893, where the water was 236 feet deep, the sample being obtained at 180 feet. The other was taken in December, as nearly as possible in the same place. The average number of bacteria was 61 per cubic centimeter. Determinations extending from April to September last, of water obtained from points not nearer the island shore than 2,200 feet, nor further than 4,040—that is, from two and one half to three miles from the mainland, and where the depths ranged from 75 to 182 feet, gave for 56 determinations, an average of 101 bacteria per cubic centimeter. This will not represent the effect of exceptionally severe winter storms, when the disturbing action of the waves extends for nearly a mile from the island. I have purposely excluded a determination made on January 19 last, when, in order to test the matter, I went out after a very heavy storm. An open boat, which as the harbor was frozen up, could alone be used, did not offer sufficient protection from the high sea and bitter cold, so that I did not venture past the intake, but there obtained two samples which averaged 7,627 per cubic centimeter, and one 400 feet nearer shore, which showed 9,335 per cubic centimeter. These figures have not been included in the general average, as I regard them as exceptional.

I think it may, therefore, be fairly assumed that within the shore distance specified, the normal number of bacteria in this part of the lake is about 100 per cubic centimeter.

DEPTH OF WATER AS AFFECTING NUMBER OF BACTERIA.

Before the present intake was located I was engaged by the city engineer to determine the most favorable position and depth. The results of previous experience led me to the formulation of a general principle, that sewage or organic matter, and the organisms that live in it, must be regarded as sedimentary, consequently, the best water would not be found at the bottom. On the other hand, moulds, yeasts, and air forms generally, might be expected near the surface. The investigation of this point coincided with this. The average for six months, for two feet from the bottom, at a depth of 73 feet, was 119, while 20 feet from the surface there were 89 per cubic centimeter. The best position was found to be 20 feet above the bottom, where the average was 66. A trial last August gave 235 for near the bottom, 190 near the surface, and 120 at an intermediate point.

I have observed a like result in the examination of localities in Lake Simsoe, and in various ponds, and am led to the conclusion that in water not violently disturbed, the least number of bacteria will be found between the top and bottom.

EFFECT OF SEASON ON THE NUMBER OF BACTERIA.

It has been generally found by those whose opportunities for observation have been ample, that though it might be reasonably expected that the number of bacteria in water would be greatest in summer, the reverse is usually the case. An inspection of the frequent periodical examinations of Thames river, made by Frankland, in 1886-7-8, shows the lowest numbers to have been, respectively, in July, May, and July, and the highest to have been in December, November, and January. In regard to the River Lea, another source of the London supply, the lowest months were September, April, and May, and the highest, December, January, and April. The returns of Miquel, for Paris, in 1889, indicate the lowest and highest months for the Seine, Marne, and Ourcq, to be respectively, August and December; September and November; and June and December. Proskauer and Plagge's report for 1886, for Berlin, for the River Spree, gives September as the lowest, and March as the highest. Fuller's statistics for 1891, of the examination of the Merrimack river water, at various points of the Lawrence, Mass., supply, show the lowest and highest months to be as follows: intake, March and October; reservoir, June and December; city hall tap, May and December; tap at experimental station, May and December.

My weekly examinations of the Toronto water supply, as shown by samples taken from the tap of the laboratory of the board of health, during the past eighteen months, exhibit a similar result, the lowest month being September, and the highest February. The year may be divided into two bacteriological periods, the first extending from May until September, inclusive, when the relative number of bacteria is small, and the second commencing with October, when the numbers suddenly increase greatly, and continue to do so until the middle of the winter, when they decline, and, about the end of April, as suddenly fall off.

Frankland, in alluding to the small number of bacteria in the Thames and Lea, during the summer months, says that it is mainly due to the fact that, during dry weather, these rivers are principally composed of spring water, while, at other seasons, they receive the washings of much cultivated land. This will not explain the case here, as the greatest numbers are found in the dead of winter, when the land is frozen, and very little water passes down the rivers. I feel confident that the large numbers in Lake Ontario water in winter are in some part due to stormy weather. Of this I had an excellent opportunity of judging, when every violent storm on the lake was clearly reflected by the bacteriological examinations of tap water.

I am, however, inclined to think that bacteria are directly influenced by season. I am not sufficient of a botanist to say whether this is not, after all, only a matter of temperature, but I am convinced that in nature, certain micro-organisms multiply most rapidly at certain seasons, and that cold water is for some of these much more favorable than that which is

warm. In September last, a yellow colony, probably that of bacillus ochraceous, made its appearance, very sparingly, on the weekly plates. When cold weather had set in, and the temperature of the water was reduced to that of its point of maximum density, the colonies of this organism were very numerous, composing the greater part of those which developed. This bacillus disappeared with the advent of summer, but during the present month, September, I have again noticed several colonies. It is possible that this is a form growing only at considerable depth, where the temperature is always low, and that it is merely dislodged, and carried nearer the surface by upward currents produced by storms. I do not, however, think that this is the true explanation, but as I have before said, am inclined to the belief that bacteria, like other plants, have their own particular seasons of growth.

I venture to throw out the suggestion that this may have an important bearing in explaining the prevalence of typhoid fever at certain times during the year. This seasonal peculiarity is very well marked in Toronto, when every September shows a sudden increase in the typhoid rate, with a corresponding decline after October. Since last May I have been paying particular attention to the temperature of tap water, which, up to the present, seems to be related to the development of this disease. I hope in future to be able to throw some light on this subject.

BACTERIA AS INDICATING SEWAGE CONTAMINATION.

The experiments of Bolton, Wolffhugel and Riedel, Frankland, and others, have shown that it is possible for micro-organisms to exist and multiply enormously in distilled water, presumably free, or at all events containing only the most minute traces of organic matter. These experiments have either been misunderstood, or so twisted from their original intention as to militate against that science which they were designed to elucidate and support. It has been asserted that the presence of a large number of micro-organisms is no criterion of the quality of water, and that a mere enumeration of colonies, is of little or no value. Without a thorough knowledge of all the accompanying conditions such evidence is certainly insufficient, though, speaking in a general way, I believe that it may be accepted that numerous bacteria indicate the existence of a sufficient quantity of food, which, in water, is commonly of the nature of sewage. "Wheresoever the carcass is there will the eagles be gathered together"; or to render the illustration more congruous, it may be said that a few weeds of a particularly hardy species, may be found on poor soil, but for number and variety, the ground must be rich.

It is for the comparative examination, at different times, or localities, of a water of known character, and for the detection of sewage contamination, that a bacterial enumeration is most useful. Its sensitiveness exceeds that of the most delicate chemical test, and it admits of conclusions which are perfectly trustworthy. In order to prove this I may, perhaps,

without being charged with vanity, be permitted to submit a few cases which have occurred, in my own experience, during the past two years.

For some time prior to 1892, the pumping well, which has already been described, was by some persons thought to be leaking, so that the diluted sewage from the bay found its way into the supply. In 1891 the death rate from typhoid stood at the extreme figure of .93 per thousand, and the people were very properly excited. Chemical analyses, by several competent chemists, had frequently been made of the water of the intake and pumping well, but a fresh investigation was ordered and carried out without any satisfactory conclusion being arrived at as to the presence of sewage. I was asked to take part in this test, but recognizing that I was no better qualified than others engaged in it, I decided to resort to a bacteriological method. The results seemed to me sufficiently conclusive to warrant a report to the city authorities that not only was there evidence of the pumping well being leaky, but that, even at the shore of the island, the water was not identical with that of the intake, and some defect must consequently exist in the pipe that passed across the island and out into the lake.

I must confess that, at this time, the friends of bacteriology were exceedingly few, and distrustful, so the report carried little weight and was quietly shelved. A subsequent accident to the 4-foot pipe across the bay diverted what little civic and public attention had been excited, and it was not until several months after that the subject was revived. In May, the conduit from the island to the intake was examined by divers, when it was found that three hundred feet of the terminal lengths of the pipe had become disconnected, and were lying on the bottom, imbedded in sand. The supply had not, therefore, been derived from the intake, where the depth was seventy-five feet, but from a shoal of twenty-five feet, that exists at this point. This was so far favorable to the bacteriological prediction.

It was next decided to test the pumping well, by emptying it completely, but this was found to be a matter of considerable difficulty, as numerous and large leaks existed, so much so that a steam pump had to be kept continually going in order to keep the well in such a condition that repairs could be carried out.

I have said that an accident occurred to the 4-foot pipe across the bay. This necessitated extensive repairs, and when completed, I was required to make a test of the work. The result showed both pipes to be leaky. Some breaks were discovered and made good, and another bacteriological examination followed, with a result similar to the first. This was no doubt far from pleasing to those who had conducted the work, and not at all reassuring to the public. It was decided that a mechanical test should be made by shutting off the pipes and taking the level of the pumping well. This critical test was made in the presence of many interested persons, who, for the most part, were very skeptical in regard to bacteriology. Both pipes were found to be leaking badly, and the vindication

of modern methods was complete. I could, if need be, multiply instances of a similar character, but suffice it to say that the city engineer and his staff have taken every advantage of the assistance of the Health Department in all matters pertaining to the integrity of the conduit, and thereby many defects have been discovered and remedied. It has been shown to be possible for the bacteriologist to keep his finger on the pulse of the conduit, so that the slightest deviations can be detected, and the public now seem to be perfectly satisfied that such is the case.

RELATION OF BACTERIA TO ENTERIC FEVER.

I cannot allow this opportunity to pass without a brief reference to this subject, which, with regard to Toronto, has already been alluded to in the last annual report of the health officer, Dr. C. Sheard. The statistics from December, 1892, to October, 1893, were therein plotted, the abscissæ being monthly periods of time throughout the year, and the ordinates the numbers of bacteria per cubic centimeter, and the numbers of typhoid cases. A comparison of the latter showed a wonderful parallelism, which might or might not have been accidental. During the two years, 1890 and 1891, in which the conduit and pumping well were admitting sewage-laden water, the annual typhoid rate was the same—, 93 per thousand, but between July, 1893, and July, 1894, when the more serious defects had been repaired, the proportion diminished to .16 per thousand. The accident which befel the pipe across the bay, on December 25, 1892, by which large quantities of sewage gained access to the supply, increased the number of bacteria per centimeter, as shown by a service pipe in the upper part of the city, from 25 to 1,040, and the monthly typhoid cases, from 35 to 112, increasing next month to 139. Judging from previous years the number of cases should have fallen at this period. The sudden rise was quite exceptional, and affords additional and very conclusive evidence of the close relation which exists between sewage contamination and enteric fever.

SAND FILTRATION OF WATER, WITH SPECIAL REFERENCE TO RESULTS OBTAINED, AT LAWRENCE, MASSACHUSETTS.[1]

By GEORGE W. FULLER,

Biologist in Charge of the Lawrence Experiment Station, State Board of Health of Massachusetts.

With the increase in our knowledge of epidemiology, and the causation of certain diseases, it has become clearer than ever before that more careful attention must be given to the quality of water-supplies. It is true that drinking-water is not the source of all deaths from diseases, the germs of which are known at times to be water-borne. Certain weight must be given to infected milk and other foods, to deficient drainage and sewerage, to neglect of laws of personal hygiene, and to other sources. Owing to the general absence of the results of sanitary analyses and of sanitary inspection, it is impossible to state at present how important is the part played in the transmission of diseases by each of these sources. In the case of water, however, it is positively known that its part in the causation of certain diseases is a prominent one; authorities differ only as to the degree of its prominence.

Sanitarians clearly realize that opportunities for supplying large communities with pure drinking-water from ground water sources, or from surface waters taken from uninhabited water-sheds, are becoming fewer and fewer. They recognize, furthermore, that the time has fully arrived when strenuous efforts must be made, in the interests of the public health, to afford practicable and reliable means for freeing infected water-supplies from disease-producing germs.

Bacteriology teaches us that water may be sterilized in three ways, by means of chemicals, by means of heat, and by means of filtration. While chemicals have been of much aid in surgery by bringing about antisepsis and asepsis, it is very improbable that people would allow their drinking-water to be drugged with chemicals, even with the view of removing dangerous bacteria—indeed, such a method might prove very dangerous in many cases. Heat is a much safer means of sterilization, and its application in the household has doubtless done much good. But on the ground of practicability and economy, as well as of reliability, in the light of our present knowledge, each of these methods of sterilization for the removal of disease-producing germs from water-supplies drops into relative insignificance when compared with filtration.

At the annual meeting of this Association at Chicago last year, I had the honor of presenting to you some of the results of the investigation

[1] Read at the Montreal meeting of the American Public Health Association.

upon water-purification made by the State Board of Health of Massachusetts. It was then shown that all disease-producing bacteria in the Merrimack river at Lawrence may be removed by slow intermittent filtration through fine sand and loam. But this is not all that the filter accomplished in the removal of bacteria. Out of 102 analyses, 58 indicated that the filtered water was absolutely sterile. Furthermore, the few bacteria which were found in the effluent from time to time belonged to the most hardy species of water bacteria, many of which existed in the form of spores and which, let it be understood, are not killed by the ordinary application of heat or of chemicals.

Spring water obtained from favorable sources has repeatedly been found to be absolutely sterile. This is the result of natural filtration. This is Nature's method of purifying water, and the efficiency of natural filtration may be attributed to the retention of the bacteria within the filter under an unfavorable environment. The natural consequence of these unfavorable conditions is the survival of the fittest bacteria. Now the evidence at hand shows that the disease-producing bacteria are among the first to succumb, because farthest removed from their natural habitat. The non-pathogenic bacteria eventually perish, also, but unlike the case with the dangerous species, this does not happen until they have established a home and breeding place within the filter. Under the most favorable conditions, filtration may be conducted so that no bacteria pass through with the filtered water. This can only be done under circumstances where the discharge from the filter is sufficiently removed, by time and distance, from the main seat of bacteria activity.

We know that there are a score or more of germs which may produce specific diseases in mankind. There are many more species which are of the utmost benefit to the human race. They accomplish their work by decomposing and nitrifying processes, and convert objectionable organic matter and disease germs to harmless mineral matter. The benefit to mankind of the saprophitic bacteria, cannot be overestimated. In this connection it is instructive to quote the conclusion from Pasteur's admirable investigations: "Whenever and wherever there is decomposition of organic matter, whether it be the case of an herb or an oak, of a worm or a whale, the work is exclusively done by infinitely small organisms. They are the important, almost the only, agents of universal hygiene; they clear away more quickly than the dogs of Constantinople or the wild beasts of the desert the remains of all that has had life; they protect the living from the dead; they do more, if there are still living beings, if, since the hundreds of centuries the world has been inhabited, life continues, it is to them we owe it."

In no place in Nature are the opportunities for this bacterial activity more favorable than in filters. We find that the purification of water, with the removal of disease-producing germs by filtration, is Nature's method. We may go a step farther and state that in the purification of

water that method is safest which follows most closely Nature's method, and which is least dependent on human agencies.

Nature's method of filtration means the intermittent application of water to sand or soil in rates equal to the rainfall. The economic adoption of sand filtration, particularly as it has been practised successfully for many decades in Europe, differs from Nature's method, strictly speaking, in that the rate of filtration is much higher and the surface of the sand or soil is covered with water for long periods of time. The essential, underlying principles, however, are the same, because the results are produced by bacterial activity which permanently exists in all filtering materials.

While the removal of pathogenic bacteria by chemicals, including coagulents, and by heat, will forever be directly dependent on human attention and judgment, I venture to predict that the day will come when the knowledge of filtration among sanitary scientists will be such that filters may be constructed and operated by which water, free from objectionable bacteria, will be supplied to hundreds of thousands of citizens and require the attention of a mere handful of men.

Even under these circumstances the opportunity for exercising personal attention and judgment can be reduced to very narrow limits. In order to obtain this desirable end it is necessary to study thoroughly the laws of filtration from engineering, bacteriological, chemical, and hygienic points of view.

For the past seven years the State Board of Health of Massachusetts has been studying the laws of filtration at the Lawrence Experiment Station. In a certain sense, the Lawrence work may be regarded as investigations upon Nature's ways of working, with a view to their more economical and advantageous application to the problems in actual practice. The results of these investigations have been published from time to time in the annual reports of the Board. It is fitting on this occasion that I review some of the more important points upon the filtration of water in the annual report of the Board for the year 1893, which is just issuing from the press.

In the operation of a filter, one of the important points is the rate at which water passes through the filtering material. As a result of European experience, the conventional limit has been set at from 2,000,000 to 3,000,000 gallons per acre daily. Recent results obtained at Lawrence show that the Merrimack river water may be filtered through proper materials at the rate of 4,000,000, 6,000,000, and even 8,000,000 gallons per acre daily, with practically no diminution in the bacterial efficiency. Farther investigations are necessary to show whether filters may work at this rate for an indefinite time without a period of absolute rest. The maximum rate of filtration allowable depends upon the quality of the water and the quality and quantity of the sand. The advantage of higher rates of filtration with undiminished hygienic efficiency is apparent because it means reduced size and cost of the filtering plant.

It is well worth noting that in the operation of water-filters a greater hygienic efficiency is obtained from uniform than from fluctuating rates of filtration. The disadvantage of fluctuating rates has been demonstrated in the case of some of the older water-filters in Europe. From the Lawrence work it appears that with filtering materials of increasing degrees of coarseness and with higher rates of filtration the advantage of uniform rates becomes more marked.

Concerning the depth of material it has been found that while very satisfactory results may be obtained, under favorable conditions, from filters one to two feet deep the deeper five foot filters are safer.

The investigations indicate that, within the limits in sizes of sand grains which would be usually employed in filtration, the finer sands are ordinarily slightly more efficient in removing bacteria than the coarser ones.

It has been stated that an objection to sand filtration of water is that the hygienic efficiency is materially reduced during the period which immediately follows the scraping of the surface to relieve clogging. In the light of recent Lawrence results, this period of somewhat diminished efficiency appears to be largely due to mechanical disturbance of the main body of the filtering material during the process of refilling the filter with water after draining and scraping it. The effect of this mechanical disturbance, caused largely by escaping air, is to create places of lessened resistance to the passage of water through the filter, thereby allowing the water to pass through certain limited areas of the material at very high rates and under abnormal conditions of filtration.

It has been found that there are reliable and practicable means of overcoming this difficulty;—one method, for instance, is by slowly filling the filter from below after draining.

In regard to the application of water to filters, there are two methods; first, the continuous method by which the filters are continuously operated with the surface of the sand constantly covered with water—and second, the intermittent method by which, from time to time, the water is shut off from the surface for a certain period and the water allowed to drain out of the sand, the pores of which fill with air. The advantage of intermittency is that it provides, within the filtering material, an additional amount of oxygen, with which the bacteria may perform their functions.

So far as the experimental filtration of the Merrimack river water at Lawrence is concerned, there is no marked difference in the average results which may be obtained by the two methods of application of water. The reason of this is that a practically sufficient quantity of free oxygen is held in the water as it flows on to the filters. In 1880 it was shown that a small amount of oxygen (one to three per cent.) in the air of a sewage filter was effective, provided that the air was changed so often that some oxygen was always present at every point. That continuous filters at Lawrence are supplied, under ordinary circumstances, with sufficient oxygen

is shown by the fact that it has never been found absent in the effluents as they flow from the filters through trapped outlets. This is confirmed by the results of long series of analyses of the effluents from both continuous and intermittent filters. Moreover, the analyses of the filtering materials themselves showed that the sand from intermittent filters contained substantially the same amount of organic matter as that from corresponding continuous filters.

To make clearer the interpretation of the investigations upon this point, let me state that the quantity of free dissolved oxygen in a water depends chiefly upon temperature and pressure. As there is practically no increased pressure upon water as it flows on to filters, the amount of free oxygen held in the water varies with the temperature and generally speaking, cannot exceed the point of saturation for the given temperature, even after aeration. The maximum quantity of free oxygen held in water varies from 1.47 parts at 32° Fahr. to 0.81 part at 80° Fahr., expressed by weight in parts per 100,000. Now it will be seen that the quantity of free ozygen, which is absolutely essential to chemical and bacterial purification of water by sand filtration, cannot exceed a fixed quantity in different waters, under parallel conditions of pressure and temperature—while the amount of organic matter in waters under the same conditions may increase within wide limits. The quantity of free oxygen within the filter, which will suffice for the complete purification of the water, must be in proportions corresponding to the organic matter. For this reason it is clear that spring waters and other waters which contain relatively small proportions of organic matter can be filtered by the ordinary continuous method with complete success, while the filtration by this method of sewage, which contains a comparatively large quantity of organic matter, is an absolute failure. Intermediate between the two in point of organic matter, a line must be drawn, below which either the continuous or intermittent method of application of water to filters is allowable, but above which the intermittent method may alone be used with safety. Not only the quantity, but also the quality of the organic matter, must be taken into consideration, for it is well known that animal matter is more easily decomposed and mineralized than organic matter of vegetable origin.

With regard to the experience at Lawrence, it may be stated that during mid-summer, the period of greatest bacterial activity within the filters, and also the time when the amount of free oxygen in the Merrimack river water is least, intermittent filters give somewhat better results. On the other hand, during mid-winter, when the Merrimack river water is saturated with oxygen, the advantage appears to lie somewhat in favor of the continuous filters because they are more protected from the effects of freezing weather.

In order to obtain the required amount of free oxygen, it is necessary in the case of some waters, and absolutely essential in the case of sewage, to charge the pores of the filter with oxygen from time to time, because

the quantity which can be applied in the water is limited by the point of saturation. Therefore, the arbitrary adoption of the continuous or intermittent method of application in the filtration of a certain water is not advisable. It becomes a matter of adjustment of the necessary quantity of free oxygen within the filter to the amount and quality of organic matter in the water under consideration.

We have now considered the way in which sand filtration does its work, and referred to some of the controlling factors in its operation. Let us next turn to the hygienic results obtained by filtration and to their interpretations.

At the Lawrence Experiment Station, during the year 1893, there were made more than 12,000 bacteriological analyses in repeatedly testing the efficiency of twenty individual filters of different construction and operation. The average results of these analyses indicated that 98.54 per cent. of the number of bacteria in the Merrimack river water were removed by filtration. This average includes all normal results, many of which were obtained from filters and under conditions which would not be recommended for adoption in that capacity. Under reasonably favorable conditions, the removal was from 99 to 99.5 per cent. of the number in the applied water. Of the average percentage (1.54) of bacteria which remained in the filtered water, in actual numbers 140 as compared with 9,100 in the river water, a majority appear to belong to the most hardy forms of water bacteria. Furthermore, it has been learned that 15 to 25 per cent. of these bacteria are present in the form of spores, which, as has been stated above, are not killed by the ordinary application of heat and of chemicals.

In studying the hygienic efficiency, we are not dependent alone on the results from these water species of bacteria. Billions of typhoid-fever germs, B. coli communis and B. prodigiosus, a species which is similar in its mode of life in Merrimack river water to B. typhi abdominalis, have been cultivated and applied to the filter. When these germs were put on to the filters, in numbers corresponding to the water bacteria, under high rates of filtration, they passed through the filter into the effluent in very limited numbers. They were present in the filtered water, however, in relatively much smaller numbers than the common water bacteria. Under parallel conditions, the ratio of B. prodigiosus to common water bacteria in the effluents, appears to range between 1 to 10 and 1 to 5. The average number of these germs, applied in pure culture to the filters, was 6,000 per cubic centimeter, of which 99.81 per cent. were removed by the filters.

The reason why such large numbers of these specific bacteria were applied to the filters was to test the efficiency of filtration under different conditions, and to obtain numbers sufficiently great to show clearly the laws of filtration. It will be admitted by every one, that the tests upon the efficiency of the filters in removing these bacteria were far more severe than would ever occur in practice. Looking at the experiments more

carefully, it is seen that these germs were applied to the filters for weeks, in numbers equal to those of the ordinary bacteria in the Merrimack river at Lawrence. At times, in fact, the numbers were a hundred fold greater. In order to appreciate more fully these experimental conditions, let me state that in order to obtain in actual practice, corresponding numbers of typhoid-fever germs, it would be necessary to add to the drainage of the Merrimack river, above Lawrence, a population sick with typhoid-fever and equal in number to the present inhabitants. This statement assumes, of course, that there would be conditions corresponding to the present with regard to sedimentation, the effect of light, temperature, osmosis, etc. It may be safely stated that the experimental conditions at Lawrence are a hundred fold more severe than would ever occur in the filtration of an ordinary water supply. This shows what a large factor of safety lies behind the bacteriological investigations at the Lawrence Experiment Station, and furthermore may serve to explain the confidence with which those who are familiar with these investigations believe in hygienic efficiency of the sand filtration of water supplies.

The results from the filtration of water at Lawrence are no longer confined to the experimental stage. A filter to purify the water supply of the city of Lawrence has been for the past year in successful operation. From an engineering point of view, this filter contains many important features which are described in the forthcoming report by its designer, Mr. Hiram F. Mills, chairman of the Committee of the State Board of Health, upon water supply and sewerage.

Briefly, it is 2.5 acres in area and contains sand of an average depth of about 4.5 feet. The depth of sand varies from 3 to 5 feet, but owing to the arrangement of the under-drains, all water passes through at least 5 feet of filtering material. The filter is situated by the side of the Merrimack river and separated from it by an embankment. Its surface is 2 feet below low water in the river. The water is allowed to flow on to the filter about 16 hours a day on an average, and during the remainder of the time the sand is drained and the pores filled with air. The filtered water is conducted by under-drains to a collecting conduit and thence to the pump-well. The pumps determine the rate of filtration, and are speeded so that the water shall pass through the filter at the rate of 2,000,000 gallons per acre in 24 hours. From the pumps the water passes to the open distributing reservoir which is 25 feet deep at high water and contains 40,000,000 gallons. The water then flows by gravity from the reservoir to the consumers.

From the time when the filter was put in operation, September 20, 1893, until May 1, 1894, daily bacteriological analyses, in addition to numerous chemical analyses, were made of the water before and after its passage through the filter, as it leaves the reservoir and from taps at the city hall Experiment Station, which are distant 1.5 and 2.5 miles respectively from the reservoir, the results were as follows:

	Average number of Bacteria per cubic centimeter.	Average percent age removed of number applied.
River	19,900	——
Effluent at filter	264	97.58
Water from reservoir outlet	139	98.73
Water from tap at city hall	90	99.17
Water from tap at Experiment Station . . .	82	99.25

The above averages include all results. Excluding those results obtained under conditions which were abnormal and not likely to occur again, we find that this filter normally reduced the bacteria from 9,000 to 150 per cubic centimeter—a removal of 98.3 per cent. of the number applied. Owing to the fact that some ground-water of somewhat unsatisfactory quality with regard to numbers of bacteria, was at times mixed with the effluent, it is very improbable that all the bacteria in the water pumped to the reservoir passed through the filter.

During the five years preceding the use of the filter, the average annual death rate from typhoid-fever in Lawrence was 1.27 per thousand inhabitants. The population of Lawrence is 50,000, and this average rate is equivalent to 63 actual deaths per year. During the past year there have been 26 deaths from typhoid-fever, a reduction of 60 per cent. Furthermore it has been learned that of the 26 who died, 12 were operatives in the mills, each of whom was known to have drunk unfiltered and polluted canal water, which is used in the factories at the sinks for washing. Among the operatives of one of the largest corporations, where canal water is not used, there has not been a single case of typhoid-fever during the past year.

The test of the efficiency of the filter during the past year has been a fair one, because at Lowell, the sewage of which enters the Merrimack river, nine miles above the intake of the Lawrence filter, there was during the past winter a severe epidemic of typhoid-fever.

In conclusion, we may state, that it has been found practicable to protect the consumers of infected water supply by means of sand filtration.

REPORT OF THE COMMITTEE ON POLLUTION OF WATER SUPPLIES.[1]

By CHARLES SMART, M. D.,

Major and Surgeon, U. S. A., Chairman of the Committee.

In a former report of this committee, after reviewing the various methods of purification of water and showing their weakness, the conclusion was reached that "A water to which sewage has access should from that fact alone be excluded from all further consideration as a possible water supply for drinking purposes"; and the question of water supply was reduced to its simplest terms: the raising of sufficient money to bring in a wholesome water, and the investment of the health officer with power to preserve its wholesome quality, and to prevent the use of water from sources known to be unwholesome. Filtration, in the former report of this committee, was not regarded as an efficient purifier when viewed from the standpoint which sees typhoid fever disseminated by an infected sewage in the water supply. Of artificial filtration it was said that it had "neither the time nor the surface to permit of percolation after Nature's method. Filtering beds of gravel are prepared which permit more water to pass through them in a day than Nature percolates through the same area in a year, or special filters are constructed which transmit under pressure as much water in half an hour as Nature purifies on the same area annually. The bacteria of nitrification cannot be harnessed to the work of artificial filtration, and hence the results of such methods, although manifesting a satisfactory freedom from suspended matters, will in no instance compare with the organic purity which characterizes the spring and well waters that are found in the laboratory of Nature." This had a reference merely to ordinary or non-specific organic matter, but when the committee came to consider the specific cause of typhoid fever in a sewage polluted water, it was equally positive that artificial filtration could not remove nor destroy this infection. The committee recognized typhoid fever propagated by well-waters that had undergone a more efficient filtration through the soil than is effected by artificial filter beds; and the story of the Lauzen epidemic seemed to indicate that a long subterranean course failed to remove the bacilli of typhoid fever.

Since these conclusions were announced the process of artificial filtration has been studied with care in this country and in Europe. The work of the State Board of Health of Massachusetts on this subject is already classical, and Professor Koch during the past year has published his views on the efficiency of filtration. The number of bacterial colonies on

[1] Read at the Montreal meeting of the American Public Health Association.

a culture field from a water has little practical bearing on the quality of the water; but the number developed from a water before and after filtration gives a better appreciation of the efficiency of the filtration so far as concerns the removal of particular substances than can be obtained by chemical analysis. Such culture experiments have shown that artificial filter beds are of material value in removing microbes, and that this removal has a protective value against typhoid fever is shown by recent experience at Lawrence, Mass., where a lessened death rate from this fever followed the careful filtration of the Merrimack water.

One of the strongest pleas on behalf of the efficiency of artificial filter beds has been made by a royal commission in its report on the water supply of London, England. The report of an inspector of the local government board had laid the blame of an epidemic of typhoid fever in the Tees river valley on the impure quality of the water supply of the Tees river. This created doubts as to the wholesomeness of the metropolitan water supply from the Thames and the Lea, and the royal commission was appointed. This commission considered the quality of the water of the Thames and Lea in relation to the propagation of typhoid fever from the standpoints of theory and experience. It showed first that the typhoid fever cases occurring annually in the valley of the Thames above the intake are so few in relation to the volume of the water that the excreta of each case would have a mass of water five miles long, one hundred yards wide, and six feet deep, for their dilution, while each case in the valley of the Lea would have a mass equal to three miles of the same width and depth. In this estimate the typhoid prevalence was taken at its highest, the river volumes at their lowest; and it was pointed out that but a small percentage of the discharges finds its way directly into the streams. Probably the greater part of the sewage of towns is distributed on farms by which most of the harmful substances are retained; and even in hamlets and isolated houses such application to land is a common occurrence, for it is the practice of medical men to enjoin that all enteric fever dejecta be buried in the soil and not allowed to contaminate the privies or middens. Second, the limited duration of infectivity of typhoid dejecta was pointed out. According to laboratory experiments the bacillus of typhoid seldom retains its vitality in fecal matter for more than fifteen days. Third, the ordinary water bacteria, thriving in their natural habitat, deprive the intruding pathogenic bacilli of the conditions favorable to their development. They undoubtedly exert an influence in diminishing the vitality of the typhoid bacillus, either actually consuming it or, as is more probable, by giving rise to products that interfere with its growth. The diminished temperature of the water as compared with that of the human body is another unfavorable condition; and the sedimentation of suspended matters is such, particularly in storage reservoirs, as to carry down with them three fourths, five sixths, or even larger proportions of the bacteria pres-

ent. Fourth, the vital action of filter beds removes or destroys any pathogenic organisms. A new filter of perfectly purified sand has little effect in producing either chemical or bacteriological purification, but in course of use a layer charged with living microbes is deposited on the surface, and it is by these organisms which constantly increase in number and also penetrate the sand to a slight distance that nitrification and the arrest of other microbes are effected. Hence the longer a sand filter has been used, the more efficient it becomes, provided it does not become so dense on its surface as to prevent the satisfactory passage of the water. This filtration by the London Water Company removes ninety-eight or ninety-nine per cent. of the microbes contained in the river water. Again so far as regards pathogenic bacteria, not only has no such organism been found in the river water, but none was found in the gelatinous layer of living microbes from the surface of a Pasteur Chamberland filter after the passage of a considerable volume of raw river water. The risk of the propagation of typhoid fever by the filtered metropolitan water is therefore regarded as very small. Moreover it must be remembered that small doses of the typhoid bacillus may probably be swallowed with impunity by a healthy person, the few bacilli entering the system being destroyed by the secretions or living cells of the alimentary canal before they are able to establish themselves.

The report then goes on to consider the evidence of experience. It shows that in the contamination of the Caterham well there was no filtration of the infected water, and no dilution at all comparable with that found in the waters of the Thames and Lea. It then discusses the epidemics in the valley of the river Tees which were attributed by Dr. Barry, the inspector of the local government board, to typhoid infection of the river water. It may be remembered that on an area of 1,100 square miles, comprising thirty-two sanitary districts and containing a population of 500,000, typhoid fever had been prevalent for years, and that within this area where an infected material was ready to breed there were ten sanitary districts containing two fifths of the whole population, in which in 1890 and '91 there occurred two sudden outbreaks of the fever, while the remaining portion of the area had insignificant fever rates. Many sanitary faults were discovered by Dr. Barry in his investigation, but no community of any such insanitary factors was found to affect the several areas invaded by the fever and besides, among localities where precisely similar faults obtained, some places suffered severely, while others enjoyed almost complete immunity. But the use of water pumped from the Tees river was common to all the affected places; and immediately prior to the epidemic outbursts sudden floods had washed vast masses of filth, accumulated on its banks, into the river, and along its current to the points of intake from which the water was pumped for delivery to certain populations; and it was these populations who suffered from the exceptional prevalence of the fever.

The representative of one of the water companies criticised Dr. Barry's

report. He admitted that the fever was more prevalent in the Tees drinking than in the surrounding districts, but claimed that the difference in this respect was much smaller than represented by the inspector, inasmuch as notifications of cases was compulsory in most of the former, and voluntary in most of the latter; and he cited the mortalities in the inspector's own tables in support of the under statement of cases in the districts not supplied with Tees water. He claimed also that many parts of the area supplied with this water escaped altogether, and that in the districts that were attacked the attacks were in parts with faulty sewerage arrangements. Moreover, he held that if the thirty-two sanitary districts were divided into urban and rural without regard to their water supply the reported fever cases would be found to have been four or five times as numerous in the urban as in the rural group. Dr. Barry in reply admitted with some qualifications the truth of these criticisms, but maintained that when due allowance was made for them there remained a body of evidence which they were not weighty enough to counterbalance, and which constituted a strong presumption that the explanation adopted by him was the true one.

The Royal Commission refrained from expressing an opinion as to the origin of the Tees valley fever, at least it was pleased to say so, but it is very evident from its further expressions that it regarded Dr. Barry's conclusions as fallacious. Returning to the waters of the Thames and Lea the Commission showed that for thirty years the inhabitants of London have been drinking these waters, and no single instance of disease caused by them has become known. In a table prepared by the medical officer to the council, London is compared in regard to its entire mortality with fourteen other great English towns which have public water supplies that are not excrementally polluted, and it is shown that in only four of these has the entire mortality on a basis of ten years been slightly lower than in London while not only has the mortality in the other ten exceeded that of London, but in four of the towns has been twice, or more than twice, as high.

The conclusion is therefore reached that there is no reason whatsoever to believe that the water, as delivered to the London consumer, is in any degree chargeable with the production or dissemination of enteric fever. There is little chance of the presence of typhoid bacilli in the unfiltered water, and the removal by filtration of 98 or 99 per cent. of the bacteria present gives efficient protection against the propagation of typhoid fever.

Professor Koch in discussing "Cholera and Water Filtration," attributes the protection of Altona from the epidemic which scourged Hamburg in 1892, to the filtration of its water supply from the Elbe. On this river are three adjoining cities, Hamburg, Altona, and Wandsbeck. The last has a pure water supply. The first at the time of the epidemic of 1892 took its water unfiltered from the river; the second took its water from the river below the sewerage output of Hamburg, but filtered it be-

fore distributing it. Hamburg was ravaged with cholera; the two other cities escaped. In one street, says Koch, which for a long way forms the boundary between Hamburg and Altona, cholera prevailed on the one side but did not cross to the side supplied by the Altona water works. The filtration at these works removed the cholera spirilla which entered the water with the Hamburg sewage. Further evidence of this was furnished during the following winter when a break in the filter bed, occasioned by freezing, permitted the spirilla to pass and was followed by a notable prevalence of the disease. According to the eminent German bacteriologist the conditions of efficient filtration such as preserved Altona from cholera, are a layer of sand at least 30 centimeters (about 12 inches) thick, the restriction of the filtration to 100 millimeters (about 4 inches) per hour, and the freedom of the filtered water from germs in excess of 100 per cubic centimeter. The slime deposited from the water is the true filtering medium, the sand layer forming merely the basis on which it is spread.

In a recent issue of the *Lancet*, August 25, 1894, the idea is scouted that Altona was saved by filtered water. The report is by a special correspondent, and in publishing it as such the *Lancet* takes the responsibility. It says: "A story is also related of some square where the houses are identical in almost every respect, and differ only in so far that on one side of this square being in Hamburg, the inhabitants drink unfiltered Elbe water, while those on the other side belonged to the municipality of Altona, and therefore received filtered Elbe water. Then follows a description of the havoc wrought by the epidemic on the Hamburg side of the square, while total immunity was enjoyed on the Altona side." The writer ridicules this and shows that the deaths from cholera became less frequent, and the houses in which such deaths occurred became farther apart as Altona was approached, but they did not stop at the boundary; they overlapped the frontier line and appeared on the Altona side. Nevertheless he is obliged to confess that the contrast between the Altona and the Hamburg side was most striking because there were at Altona only 3.47 cases and 2.13 deaths per thousand of the population, while in the adjoining Hamburg district of St. Pauli there were 25.03 cases, and 12.56 deaths. But the *Lancet's* correspondent claims that the immunity of Altona during the last epidemic is no exceptional circumstance, and he shows by official figures that in previous epidemics Altona enjoyed comparative freedom from the disease at a time when its water supply was not filtered. Nevertheless the authorities of Hamburg appear to have placed faith in the theory of water propagation as enunciated by Professor Koch. The construction of filter beds was hastened so that by May, 1893, they were in full and satisfactory operation, and the fact that there was no recurrence of the disease in that year is attributed to the filtered water. The beds have an area of 137,000 square meters, and filter at the rate of one and a half meters per day, or 62½ millimeters per hour, Koch's limit being not more than 100 millimeters per hour. The daily supply furnished by

the active filtering area is from 120,000 to 130,000 cubic meters, or nearly 60 United States gallons daily per head to the population.

In this country until recently little effort has been made to construct artificial filter beds. The experiment at Poughkeepsie, N. Y., was considered a failure on account of difficulties in management dependent on climate. In winter there is the liability to freeze. The superintendent at one time reported that he had been obliged to take off 300 tons of ice from an area of half an acre before he could reach the bed, and frequently the bed would freeze while he was cleaning it, so that the sand had to be picked up and thrown out, increasing cost and endangering the bed. In summer when the temperature reached 70° Farenheit, the growth of algæ gave the pond taste and a brown color to the water. More recently it is said that this filter has been doing better; that the growth does not affect the color or taste but merely tends to choke the filter, and that the running expenses have fallen to $2.94 per million gallons. The filter is small, only two-thirds of an acre, and it filters at the rate of two million gallons per acre. Hudson and Ilion, N. Y., and Nantucket, Mass., also have small filter beds. At Ilion the water is aerated prior to filtration. The water of a small stream is dammed up and turned into a gravity main for transmission to a storage reservoir. This, which contains fifteen million gallons, is filled from the main by a fountain of seventy ring-nozzles from three-sixteenths to one-half inch in diameter. From these the water is thrown high into the air, where it breaks up into a multitude of small rain like drops before falling into the reservoir. The discharge is about 900,-000 gallons in twenty-four hours. The underdraining of the filter beds is by two courses of bricks laid dry. The lower course is placed end to end in lines at right angles to the main collecting drain with spaces equal to the width of a brick between the lines. These spaces when covered by the second course of bricks form the collecting channels. The bricks are covered with six inches of pea gravel and over this thirty inches of sand of uniform grade. After passing through the filters the water is collected in a clean water basin for distribution. It is expected that the oxygenation of the water by spraying it from the mains will permit of efficient nitrification in the filter beds without calling for their occasional disuse to admit of aeration of the pores.

In England some experiments have been made on an oxygenation of the filter by laying pipes in the underdrains and forcing air under a low pressure into the lower layers of gravel. Continuous filtration is said to give excellent results in the new system at Ilion, N. Y. Artificial beds have recently been put in operation at Mount Vernon, N. Y. The available area is somewhat less than one and one-fourth acres. The filtering sand is one and one-half to two feet deep (45 to 60 centimeters as compared with Koch's minimum of 30 centimeters). It is divided into beds each fifteen feet wide and each six inches higher in the centre than in the depressions, so that when water is admitted it passes into the depressions

and rises gradually over the beds. The objection to this is that filtration in the depressions will be more rapid than through the centre of the beds.

The filter at Lawrence, Mass., opened in 1893, measures two and one half acres and filters five million gallons a day. It is divided into beds with depressions between so that the water may rise gradually over the sand, but a finer sand is laid down in the depressions to equalize the filtration movement. The depth of sand in these beds is five feet. The sewage from Lowell and other towns on the Merrimack was estimated at one gallon in 600 gallons of the water passing Lawrence. The annual death rate from typhoid fever for the five years preceding the opening of the filter beds was 127 per 100,000 of the population. Since the opening the rate has been reduced to twenty-six. It has already been pointed out by this committee that in cities using a surface water as a general supply the death rate from typhoid fever is in a measure proportioned to the amount of sewage inflow into the stream above the intake. When much care is exercised in preserving the purity of the water, the average annual death rate for a series of years becomes reduced to twenty-five, twenty, or even fifteen per 100,000 of the population. But no matter how pure the general supply may be, we seldom find rates lower than that last mentioned. This is to be attributed to the fact that typhoid fever may be propagated in other ways than by an infected water supply. It may, for instance, be imported into a city by individuals who have travelled during the period of incubation. In crowded and unclean tenements typhoid fever may seem to be directly contagious by the inhalation or swallowing of infected dust from soiled bedding or other articles or by the transference of the typhoid bacilli into the stomach by eating with unwashed fingers. The susceptibility of washer-women and others who have handled the undisinfected body linen of fever patients is now well understood. The propagation of the disease by the leakage of sewage into wells is fully appreciated, but the infectious character of sewer air for so long a firmly established belief, is now laid aside in view of bacteriological experiments. Nevertheless, it is possible that typhoid bacilli may be present in sewer exhalations, particularly when the exhalations are taken in their full strength, as in the steaming overflow from a sewer ventilator. Nor must we forget the possibility of de novo cases or those which many medical men regard as de novo cases caused, irrespective of a previous case, by organic exhalations, *i. e.*, bacterial exhalations from the organic matter of a soil drier than that which gives rise to malaria; or even caused by some abnormal condition of the intestinal contents which permits of the development of pathogenic qualities by a native and ordinarily harmless intestinal bacillus. With these questions we have at present nothing to do, except as they remind us that typhoid fever may be propagated in other ways than by the infection of a general water supply. The royal commission cited above is of the opinion that if typhoid bacilli enter the waters of the Thames and the Lea and survive

the conditions affecting them in the current they are separated by the filter beds, which remove ninety-eight per cent. of all micro-organisms present in the unfiltered water. The typhoid fever death rate of twenty to twenty-eight, presented by the mortality returns of London, must therefore express the prevalence of typhoid fever as propagated by other methods than the water supply. In view of this line of argument we may therefore regard the typhoid rate of twenty-six at Lawrence as a satisfactory proof of the efficiency of filtration, as there conducted, in removing the infection from a highly polluted river water.

From this brief review of facts and opinions concerning filtration, it will be seen that your committee hesitates to reaffirm its former positive language with regard to the inefficiency of filtration as protective against typhoid fever. Nor, on the other hand, do we regard the testimony as authorizing a formal declaration of opinion in favor of the efficiency of filtration. Our experience in this country is, as we have seen, extremely limited; but it is hoped that the success achieved at Lawrence will lead to the filtration of other surface waters, each of which will probably teach an important lesson in connection with bacteriological experiments and with the mortality from typhoid fever before and after the construction of the filter beds. If every municipal health officer would calculate the typhoid death rate of his city, with the understanding that any annual rate over twenty-five per 100,000 of the population is due to preventable causes, and probably to the character of the water supply, he would be in a position to urge important improvements in connection with that supply.

The question of rapid or mechanical filtration with the use of coagulants as in certain patented processes has been discussed during the past year. These, the descendants of the Hyatt and Newark filter, furnish a rapid stream of clear water for several hours, and then wash the filtering sand by the disturbance created by a reversal of the current continued until the wash water comes away clear. The conditions in these filters are so unlike those of natural filtration that your committee, when referring to them on a previous occasion, gave expression to its unfavorable views but desired information as to the results obtained. Recently F. W. Cappelen, C. E., Minneapolis, reported to the city council on the applicability of mechanical filtration to the river water of that city. This gentleman inspected the filter plant at New Orleans, La., put in by the New York Filter Company, where the contract provided for 14,000,000 gallons of clear water, free from opalescence, every twenty-four hours, the resistance in the filters not to exceed fifteen pounds when dirty nor six pounds when clean, with a certain restriction on the expense for coagulants.

The river water at New Orleans contains turbidity which resists a natural sedimentation for many days, notwithstanding the large quantity of sandy particles which fall readily. The plant is said to have worked well with one and one half grains of alum during the six months of the

year that the water is loaded with impurity and with five eighths of a grain during the other half of the year when the watei is in better condition. At the time of Mr. Capplenton's visit, "the water was the worst so far met with, and for two days baffled the efforts of the filter company to comply with the contract, and only after using two and one fourth grains of lime with two grains of alum per gallon was clear water obtained." Nevertheless, he was impressed favorably with the results and recommended a plant of this kind for his own city.

The *Engineering News* in discussing filtration for the water supply of Providence, Rhode Island, looks at these methods of mechanical or rapid filtration from a financial standpoint, and gives no information as to the efficiency of the filtration other than that a clear water is obtained; and in a letter to the editor the vice-president of one of these filter companies endeavors to show that filtration by the method of his company is cheaper than by the construction of sand filter beds, a position which is denied by several eminent civil engineers. With this question we have little concern, so long as sanitary questions relating to the chemical and bacteriological qualities of the clear, filtered water have not been answered. These filter companies have been long enough before the public to have had time to demonstrate more than the clearness of their filtered water if there was more than this to be demonstrated.

Your committee can hardly leave the subject of water filtration without referring to the importance which Professor Koch gives to the stores of filtered water which are to be found in the subsoil, even in soils which have been much and for a long time contaminated, as in that of Berlin. He testifies to the bacterial freedom of such waters. Especially is this the case, he says, if the boring goes through an upper impermeable layer into deeper sand or gravel layers containing the water. Your committee can readily accept Professor Koch's views as regards deep well water which filters for long distances between impermeable layers; but in view of the many bad waters that are contained in shallow wells, we feel satisfied that the filtration into them is inefficient.

The German bacteriologist attributes all epidemics from wells to unfiltered inflow through cracks and fissures, and proposes to remedy this and reclaim the water supply by inserting an iron pump and filling up around it with gravel and sand so as to insure an efficient filtration to the lower end of the pump. We have seen that at Lawrence, Mass., artificial filtration through five feet of sand apparently purifies a sewage polluted water; why, then, should not Koch's views be correct, and a natural filtration through many feet of sand and natural soil be equally efficient? The answer to that is that in our cities the danger to wells comes not from the surface, but from the subsoil. We may fill our wells with sand, and every drop of surface water may be efficiently filtered, but the dangerous leakage may be from some subsoil channel between a leaking sewer and the well. Hence we consider that our municipal health officers have done

well in closing up all subsoil wells within their jurisdiction; because it is not surface inflow which we fear, but subsoil inflow. Of course, if chemical or bacteriological examination shows contamination either from the surface or the subsoil, all such wells should be condemned.

Before concluding this report the committee desires to refer briefly to the Potomac water supply of Washington, D. C., as the report of a medical commission on the prevalence of typhoid fever in that city forms part of the record of progress during the past year. The Potomac river supply is distributed by gravity, with no purifying process to free it from sometimes very large quantities of suspended clay and associated organic matters washed down in part from farming lands and such settlements as Harper's Ferry. A committee of the district medical society, appointed to investigate the subject, acknowledged the unusual prevalence of typhoid fever, an average annual mortality rate of about seventy-five per hundred thousand of the population, but attributed it first and chiefly to the use of well waters; and the wells are now undergoing chemical and microscopic scrutiny with a view to closing up any that furnish water of a doubtful quality. The evidence on which the typhoid prevalence was attributed to the wells is not so clear as to satisfy every one, and particularly do those who have been deprived of their well water object to the conclusions of the committee. Many other conditions likely to promote the prevalence of typhoid fever were mentioned by the committee as present in Washington, D. C., and suitable recommendations were made in each case; but it was not until sixthly was reached that a suspicion was thrown on the general water supply.

In view of an unbroken record of typhoid fever in communities that use raw river water, and an equally unbroken record of lessened typhoid rates following the filtration of such river supplies, your committee considers that in Washington, D. C., special attention should have been given the improvement of the general supply. This country needs some practical lessons in methods of water purification. Lawrence, Ilion, and Mount Vernon have been contributing to the general good, but aeration and filtration at the National capital would have done more to suppress typhoid fever in this country than by merely reducing the typhoid death rate in Washington, D. C. It would have led to a more general interest in improved water systems, and brought the question home to many municipalities.

In conclusion your committee desires to invite attention to a proposition emanating from the McGill University of this city, for which credit is to be given to Professors J. George Adami and Wyatt Johnston, the latter a member of this committee. Impressed with the difficulty of reconciling observations made upon water bacteria with the descriptions of the various species that have been published up to the present time, and recognizing how much good and useful work is lying unpublished and incomplete from the fear lest publication should, after all, result in renaming species that have already been described and adding to the

confusion already existing, these gentlemen desired to do something to aid in remedying the present unsatisfactory conditions. As the task of establishing order out of the present chaotic state of the literature of the water bacteria is too great for one man to undertake, the idea of a coöperative investigation offered the only prospect of a speedy advancement in this line of work. "If," says Professor Adami in a letter to the chairman, "in such a combined investigation one group of water bacteria were to be assigned to one laboratory for study and classification—one laboratory for example dealing with vibrios, another with the B. coli group, another with the fluorescent forms, and so on; and if each laboratory were to send to the investigator of one special group every distinct variety of that group making its appearance in the waters studied in that laboratory, the mass of material so gained would form an ample basis for an authoritative monograph upon the members of that group found in American waters; and such a monograph published in this way would of necessity become the standard of reference." There are of course several details in connection with such a scheme requiring careful elaboration in order to make success attainable. Details of modes of classification, of preparation of standard media, of periodic conferences of those engaged, of method and locality of publication, etc. All these would have to be considered and determined according to the wishes of the majority of those interested before a start could be made; but the settlement of these details ought not to present insuperable difficulties.

Your committee consider that a great advance may be made by the development of this suggestion; and to further the accomplishment of this, it recommends that when its membership for the coming year is announced, it may be authorized to increase the number of its members by adding to the list the names of such investigators as may be willing to coöperate in this scheme of bacteriological study.

DISCUSSION ON THE FOREGOING GROUP OF PAPERS FROM "THE CART BEFORE THE HORSE" TO THE "REPORT OF THE COMMITTEE ON THE POLLUTION OF WATER SUPPLIES," INCLUSIVE.

Dr. C. O. Probst, of Columbus, Ohio.—In connection with the suggestion that closed the report of the committee on the pollution of water supplies, I desire to introduce a resolution. I think we are all glad to have the report of a committee which has carried this matter of the bacteriological investigation of water further than it has been done heretofore.

In our state (Ohio), within the last year the responsibility has been placed upon the State Board of Health of improving and approving the public water supplies of our cities and towns. We have felt that the chemical examination was scarcely satisfactory, and we have not been very well satisfied with the bacteriological examination which simply told us how many bacteria there were to the per cubic centimetre. So I think the suggestion made by the committee is a good one, and I therefore present the following resolution:

Resolved, That this Association approves the suggestion of a coöperative investigation into the bacteriology of water, and commends the efforts of the Committee in carrying out this work to the officers of the State and municipal boards of health, to the individual members of this Association, and to all persons interested in the purity of water supplies, for such special assistance as they may be able to render.[1]

Dr. Gardner T. Swarts, of Providence, Rhode Island.—The question of filtration of water supplies is an interesting one, and I think a greater interest will be taken in it in the future than there has been in the past. It is one which Boards of Health will be now called upon for an expression of opinion which shall have some value. The work done heretofore by the State of Massachusetts at the Lawrence station has been of immense value. It has been accepted through the world as a standard by which we can guage our future work in sand filtration. It has also been of assistance to the health authorities of Germany and other countries in making a comparison of their work with that of other countries.

I think the papers read by Mr. Fuller, and by Dr. Johnson in reference to sedimentation in water, are extremely important, and that by Mr. Fuller is more so because it gives us the results of sand filtration and the practical value arising from it.

The report as given by the committee is a most excellent one, and one which can be read and reread and information obtained upon each reading. It has dealt with the subject in a fair manner, and that phase of it pertaining to typhoid-fever was particularly interesting. The question arises, shall we require that all water be filtered *mainly* upon the question of the presence of pathogenic bacteria? That is to say, the typhoid bacilli or cholera spirillum may be found permeating our water supplies, being placed there by persons having contracted the disease; then the germs being ingested by others and the disease reappearing. Shall we then base our judgment of the results of different methods of filtration upon the presence or absence of bacteria in the effluent? With reference to the subject of bacteriology, I will say that I have been a laboratory worker for six or seven years, and while I do not wish to decry it, I think we are led to extremes in the matter, and I do not consider the subject in all its phases as definitely decided. The subject is so fascinating that we are led in any one direction so rapidly that we are apt to go astray or lose our heads. As to whether the typhoid germs enter our water supply and find their way from place to place and into the bodies or systems

[1] This resolution was reported upon favorably by the Executive Committee and adopted by the Association.—Sec.

of individuals, I think it has been shown more than once that all typhoid bacilli do not enter our bodies through a polluted water supply. Let us consider the question for a moment as to whether typhoid-fever is alone dependent upon the presence of the bacillus. There is no question in my mind and that of many other observers who agree with me, that the ingestion of sewage thrown into our water supply has been known to produce a condition of the system with all the clinical symptoms and pathological conditions of the intestinal tract which cannot be distinguished from typhoid-fever, and in which the bacilli of typhoid are not present. Instances of the kind can be cited. I have in mind a hotel which was infected by the presence of sewage matter running directly into the well supplying the hotel. The guests were all infected, and I do not believe in that case, that bacilli were present of the typhoid variety. The fact is we are obliged to accept the statements of clinicians who make their diagnoses on the symptoms. When the wells become low in suburban districts and the drain upon the surrounding areas is so great that the bacteria are present in great quantity, the decomposition of organic matter by the bacteria produces ptomaines or poisonous products which will, I think, affect the system exactly in the same way as the bacillus colli communis, which is becoming so constant and is so frequently found in the dejections of people under all conditions, and I think the time will come when that will be found as causing the same lesions in the system as the typhoid bacillus, especially when the intestinal tract has been devitalized by the constant presence of decomposition such as decayed animal or vegetable matter or by the constant retention of foecal matter.

The committee has spoken of the question of mechanical filtration. It refers in the report to the fact that the city of Providence has considered the question of filtration of its water. I had hoped if time permitted to read a paper giving the results of the work that has been done by that city for the past twelve months.

I believe that the committee states that the only report that has been available, was, that clear water was obtainable from mechanical filters, and by mechanical filters I mean the use of coagulents and also mechanical means for agitating the sand and cleaning the filter. A series of experiments upon mechanical filtration were carried on for a period of nine months in Providence, which was not stated by your committee, and the filtration commission had sufficient time to determine whether or not the water was filtered properly. The city of Providence asked the filtration company if bacteria could be removed by filtration, and the answer was that they did not know. Upon investigation of the literature of this and other countries nothing could be found. Therefore experiments involving several thousand dollars were undertaken by the city of Providence and a filter, half the size of an ordinary filter was put up and operated for a period of nine months. As I was personally connected with those experiments and made the bacteriological examinations from day to day from the filters, I can say without equivocation and without any question that the bacteria were removed in all cases where the filter was used, and in all instances the number of bacteria removed was greater than by sand filtration. This work was preceded by a prejudice against filtration after having had experience with household filters, and having condemned them as incubators, I was also inclined to condemn the process by the use of coagulants. The results showed that over 99 per cent of the bacteria were removed, and that none of the alum used as a coagulent was to be found in the effluent. The amount found necessary was one half grain to the gallon, more or less than this amount was found to give poorer results. This question of filtration is still in abeyance. It will take years before we can positively determine the advantages of one filter over another; but thus far in examining filters for artificial experimentation, the difference in advantage is in favor of the mechanical filter. The slimy material, the number of organisms and organic matter which accumulates on a sand filter are objectionable to the sight as well as to the sense of smell, and the ptomaines which may form in the filter may prove to be an objection. The advantages of using a mechanical filter are these: It does not clog; and where three or four million gallons of water can be filtered through a given area of sand, one hundred and twenty-five million gallons can be filtered through the mechanical filter in the same time. Furthermore, it is under control of the operators. It is claimed by the opponents of the mechanical filter that the sand filter is one which takes care of itself, while the mechanical filter requires some one to take care of

it. It is considered as an offset to the expense of having an experienced man, an engineer of ordinary ability to attend to something which is under self-control. These mechanical filters can be cleaned thoroughly in a few minutes. The question of cost has been brought up by the council of the city of Providence, and has never yet been decided by the city engineer himself who is in favor of sand filtration. The figures show that mechanical filtration is the most expensive. It has been shown by the original expense of sand filtration, that it depends a great deal upon the place where the filter beds are located, the cost of erecting the structure, etc. If we take into consideration these things we will find that mechanical filtration is not as expensive as sand filtration. I do not wish to be understood as being a representative of any mechanical filter company, but I am simply giving you a summary of the results of my experience and experiments and the opinions I have derived from the connection of which I have spoken.

In connection with the resolution providing for a study of water bacteria which has been read, I should like to state that with what facilities the State Board of Health of Rhode Island have, they will assist in every possible way.

Dr. J. H. Gardner, of London, Ont.—In reference to one of the papers read this morning, namely "The Cart before the Horse," I desire to offer the following resolution :

Resolved, That in view of the danger to the public health by the contamination of our fresh water lakes, rivers, and streams, that this Association memorialize the different federal governments as well as the states and provincial governments to pass laws prohibiting the contamination of these water supplies by sewage from cities, towns, and villages, and compel them to provide some means for the treatment and oxidization of this sewage before emptying it into these places.

(This resolution was referred to the Executive Committee.)

Dr. A. N. Bell, of Brooklyn, N. Y.—I wish to say a few words about Dr Lee's paper with reference to the horse and cart. It is not with a view of criticising his paper, but with the idea of magnifying its import. Looking upon the sanitary service generally, and its equipage as the horse, and the great public as the cart, I will risk the criticism—though I know there are some prominent exceptions—that the horses are habitually neglectful of their duty; that they allow themselves to be led by the cart, await reports and consequences of disease sometimes before moving against the causes. I would make this criticism against my own city if I thought it deserved it, but I believe it does not deserve it any more than the health service generally, I might venture to say, in Canada as well as in other states throughout the United States. While my observation which is somewhat extensive, and my correspondence which is still more so, justify the opinion I hold in stating that the health service of this country habitually waits upon the public to report to them cases of sickness, instead of doing pioneer work and going forward and exposing those causes which will produce disease before the disease occurs, I would be the last one to be unjust in anything I might say regarding health officers. I know there are prominent exceptions, but I venture the opinion that nine out of every ten of the sanitary inspectors throughout the province of this association will usually await the report of some public person or some policeman to tell them there is a nuisance at a certain place which ought to be removed because it has made some one sick, instead of the sanitary inspector doing the inspection service as he should do, and pointing out these things before they make people sick.

I endorse every word of the paper with reference to water supply in relation to drainage.

Dr. Peter H. Bryce, Toronto, Canada.—Inquiry regarding the report of the disposal of sewage reveals that there is no such report. It has therefore struck me that the committee in preparing this report on the pollution of water supplies has overlooked what would seem an important part of its duties; namely, the very wording of the report itself, the pollution of water supplies. As I understand it, the report has dealt solely with the question of the purification of polluted water supplies. I think we may excuse them owing to the limited time at their disposal for preparing and presenting the report, and taking up the question

which seems to be embodied in Dr. Lee's paper of the cart before the horse. It would have been desirable for the committee to consider the pollution of water supplies, and then after having dealt fully with that question, it could then dwell upon how we are going to make them pure after they have been polluted. While the committee has done splendid work with regard to purification of water, I think most of us as working health officers must also feel that more attention should have been given to the question of how to prevent pollution, and how to purify our water supplies. From the standpoint of my own province, one of our most difficult tasks is that of how to prevent pollution. It seems to me that in the natural, progressive method of sanitation with regard to the disposal of sewage and keeping our water supplies pure, the energies of sanitarians should be devoted rather to the question of how are we going to dispose of the sewage, whether by filtration or otherwise, and thereby keep our rivers and our public water supplies free from contamination. If we can in any way lessen the dangers which are manifestly present and which have to be averted in some degree from these sources by the proposed plan of purification, we shall have accomplished something. I think, without discussing the matter further, that the committee might continue its labors and take up the other phase of the question of the pollution of our public water supplies, leaving the matter of purification for the time where they have so well brought it today.

Mr. JOHN MITCHELL, New York City.—I listened with pleasure to the reading of Dr. Lee's paper. It seems to me a popular subject, and I noticed that there was no desire on the part of the writer to assail the plumber. Sanitary plumbing was referred to. I am a master plumber, representing today the National Association of Master Plumbers of the United States, and feel that a paper of that character commends to this body the necessity for immediate action. The plumbers of my own state, and of the United States, whom I represent, are heartily in favor of good sanitary plumbing. They believe in rigorous laws and their prompt enforcement. As I understand it, the origin of disease is in a great many instances due to impure water and bad drainage. The needs of the bath room, and openly constructed fixtures, as referred to in the paper, emptying into a cesspool or draining improperly on the outside, leave the internal work a farce and an absurdity. This body, representing the education and knowledge of the different sections of the country, has considerable power, so far as the legislatures of the country are concerned, in the passage and enforcement of laws in a sanitary direction—prompt inspection without waiting for complaint, ferreting out the prominent causes of disease in defective plumbing, and defective architecture in our buildings. The architect, the contractor, and the house owner throw the responsibility and guilt upon the man who is simply hired to place the fixtures in position. We desire no such responsibility without protestation. As a trade, we are in favor of prompt, earnest, and active enforcement of laws, of competent examination of all participating in our business. The state of New York has given us a law, but its departments fail to carry it out. They shift the responsibility from one department to the other, and we have got to go back and seek further legislation. The plumbing interests of the country require the carrying out of laws, and the laying out of plans that shall be so simple and clear that there can be no mistake in the future. I agree with what Dr. Lee has said, except in this particular, that on behalf of the gentlemen I represent today, I think no responsibility should be placed upon the plumber because he has no participation in the plans of the work laid out. We have to carry out the plans and specifications of the architect and of the various departments; they assume the responsibility, and we are simply the gentlemen called upon to place in practical operation the work.

I hope that this body, drawing as it does its members from all parts of the country, will show their interest by appealing to the municipal boards, to state boards, to legislators for the enforcement of laws, for clean, pure water, perfect drainage, and for competent workmanship.

Dr. BENJAMIN LEE, of Philadelphia, Pa.—Among the feast of good things which we have had before us today, it would seem invidious to refer to any particular paper, but the whole subject of filtration and purification has been so thoroughly touched upon, that I may be pardoned for calling attention for a moment to a paper which appealed to me most in the work which I have to do

myself, and it was the one which described the constant pollution of the homestead well. In my own state there are very few health authorities, and none in the rural districts, hence all cases of an epidemic nature are referred directly to the state board of health. As a consequence hardly two or three cases of dysentery or typhoid fever occur but what I am at once appealed to as an executive officer. The number of instances in which typhoid fever, bilious fever, malarial fever, and dysentery can be traced to polluted waters has been astonishing to me, and if there is anything still more astonishing it is the reverence with which the average farmer looks upon his family well. It is not exceeded by the sacred character which he attributes to his family by it, and the health officer who attempts to cast aspersion upon it is running some risk. He will say to you, "What nonsense you are talking to me. My father used that well, his father used it, and his father's great grandfather used it, consequently it is good enough for me." It never seems to enter their heads that during all these generations they have been using that well, and have been depositing effete material in close proximity to it, which constitutes the reason why it should not be longer used. So that I believe in accordance with the paper, and somewhat in opposition to a paper presented at the last meeting of this association, that the pollution of the family well in rural districts and in villages is one of the most serious sources of disease of that nature that we have to contend with. I believe it often exceeds the matter of the water supplies of great cities and their protection from pollution.

I would like to say with reference to the remarks of the gentleman who has taken his seat (Mr. Mitchell), that I trust it was not supposed that there was any implication or reflection on the great association which he represents in what I said in my paper. The allusion I made was simply one factor in the general process of the diffusion of filth by modern plumbing.

Dr. C. A. Lindsley, of New Haven, Conn.—It is not a violation of nature if we do put the cart before the horse, for I believe it is sometimes necessary to have it so. In the line of introducing water into a new place which must be followed by the introduction of sewers, the cart is before the horse, but it produces the desired effect. I had a recent experience in Connecticut of the horse before the cart, and it was a total failure. In one of the cities in Connecticut there was an inspector of plumbing whose business it was to inspect every new house to see whether it was satisfactory or not, and they with commendable prudence passed a law that before he could be sworn into office he must get the approval of the state board of health after passing an examination. It was the first instance we have ever had of that sort in Connecticut. The man appeared before a committee of the state board, and we gave him what we thought were very simple questions to answer. He claimed to be an architect who had designed many houses and planned plumbing, and it was supposed that there would be no question of his passing an ordinary examination, but to our surprise he failed, and we were unable to give him our approval and so reported to the common council. The chairman of the board of health of that city, who was a member of the city government, came to the committee and remonstrated about it. He thought under the circumstances the committee ought to reconsider its action, but we declined to do so, and then their mayor came a distance of some twenty miles or more and begged of us to reconsider our action. We replied we thought the common council should reconsider its action, and as we did not care to make a farce of it by declaring that the man was incompetent, they reconsidered their resolution and allowed him to be sworn into office without our approval. That put the cart before the horse and reversed the arrangement.

Dr. S. W. Abbott, of Massachusetts.—In illustration of Dr. Lee's timely paper, allow me to refer to more recent legislation in Massachusetts upon matters relating to water pollution. We have some excellent laws of a broad and general character, like the law of 1888, entitled "An Act to Protect the Purity of Inland Waters," and at the same time we have other laws relating to the same question which are virtually inoperative.

It so happens that people from different parts of the state occasionally come up to the legislature with urgent claims for better legislation upon this subject. They appear before the committees on water supply and drainage and urge the importance of new and better legislation. These good people return to their

homes in the hope that some efficient law may be enacted. Meanwhile discussion actively ensues in the legislature; the manufacturing interests succeed in tinkering the bill, and when it finally appears as a law in the blue books, we find a very good example of the "cart before the horse."

An example of this character appears in the legislature of 1886, when an appeal was made by people who were being served with ice from polluted ponds and streams, for better protection by law. When the law was finally enacted it appeared as follows:

Acts of 1886, 287, § 1.

Upon complaint in writing of not less than twenty-five consumers of ice which is cut, sold, and held for sale from any pond or stream in this Commonwealth, alleging that said ice is impure and injurious to health, the state board of health may appoint a time and place for hearing parties to be affected and give due notice thereof to such parties, and after such hearing said board may make such orders concerning the sale of said ice as in its judgment the public health requires.

That is to say, the burden of the law rests, not upon the parties who pollute the ice supply, but upon the dealer who sells the ice. The law has been practically inert, and the only occasion in which it has ever been employed was in the case of an ice dealer who desired to break a contract with the owner of an ice pond which this dealer had hired. Acting under the advice of a sharp attorney, the ice dealer himself had the petition drawn up and signed, and presented to the board for its action.

The pollution of the pond was here a secondary consideration, and could scarcely be said to exist at all.

Dr. Charles Smart, U. S. Army.—I was unfortunate in not being able to hear the remarks of Dr. Bryce in criticising the work of our committee. I understand that he stated the committee had lost sight of the pollution of streams and had changed its work to the purification of them. The committee, as I understand it, was organized in order to inquire into the pollution of streams, not with regard solely to prevention of pollution, but that if the pollution could not be prevented we were to direct our attention to the purification of the pollution. I do not think the name of the committee is on the prevention of pollution of streams, but rather on the pollution of water supplies. The committee at this meeting simply reported progress on the pollution of water during the past year. We have had nothing to report in the way of prevention of the pollution of streams, but we have had a good deal to say with reference to purification. In defense of the committee, I deem it necessary to make these remarks. I am thankful, at the same time, to Dr. Bryce for his forgiveness.

MANAGEMENT OF DIPHTHERIA EPIDEMICS IN RURAL DISTRICTS.[1]

By CHARLES A. HODGETTS, M. D., L. R. C. Lond., Toronto, Canada.

The appearance, in epidemic form, of this peculiarly infectious and contagious disease, so insidious in its beginning and progress, and often so fatal in its effects, is, so far as our larger towns and cities are concerned, well within the control of our health officers, though often presenting difficulties as to origin and spread. In these populous districts there exist organized boards of health, with the necessary officials to promptly act upon the notification of even the first case, thereby greatly lessening the danger of its becoming epidemic. The medical health officer of a large centre is, as a rule, provided with armamentarium necessary for the disinfection of premises, clothing, etc. His officials are properly trained to carry out all his instructions. Efficiency in the management of epidemics has here been reached by experience. But in our rural districts the conditions are so much different, and what is our experience is, no doubt, that of many others in similar districts of this continent; and it is with the view of gaining from the experience of those who have had to manage such like epidemics that the subject is brought before you. We spend much time upon the application of theory to the practice of preventative medicine, as it relates to the more populous districts—pardon me, therefore, if I lure you to "The land of the axe and the hoe," for I feel that the inhabitants of the rural districts should receive more attention from the sanitary authorities than they have hitherto; and some inexpensive system should be adopted for the more efficient and prompt management of epidemics in these portions of our country.

From time to time the Provincial board of health of Ontario has been called upon to cope with epidemics of diphtheria in different districts of the province, sometimes in the older and more settled regions, but more often in the newly opened townships bordering upon the vast timber limits to the north, where, if the inhabitants are more free from the ravages of infectious diseases, yet from almost the total absence of medical aid, the results are more fatal. The difficulties to be met and surmounted are different from those presented by an outbreak of the same disease in urban districts. From an insidious beginning it extends over a wide area, often several townships, and its victims are many before a report reaches the executive, an interval of several weeks frequently occurring between the date of its first appearance, and the time when the true condition of affairs is ascertained.

[1] Read at the Montreal meeting of the American Public Health Association.

To a better understanding of these epidemics I would direct your attention to the topography of the districts. Communication is carried on by means of one government road, from which digress various side roads leading to a few clearings or a small settlement. At intervals along, more especially the main road, are lodging houses, the abode of a settler and family, often large, for they have both time and inclination for such luxuries, "far from the madding crowd." More distant, at the termini, are to be found the lumber camps, becoming active in the early fall. The employés for these camps journey along the roads, calling at the various wayside houses; and my experience is, that usually the epidemic begins with one of these men, who has either had the disease himself and has left his home in the city or town before making a complete recovery, or else carries the contagium with him. His mingling freely with the members of the household affords an easy method for the spread of the infection, finding a suitably prepared nidus in the follicles of the already inflamed tonsils; for of some hundreds of throats examined while in charge of epidemics of this disease, in less than five per cent. have I found tonsils free from inflammation. The reasons for this are, of course, not to be noticed here; but sore throats are so common that the early cases of diphtheria are passed unnoticed until a death or two happens. Now medical aid is summoned from the nearest point, many miles away. The discovery that the disease is diphtheria causes a condition of affairs little short of a panic. Many have unwittingly exposed themselves to the infection in attendance on the sick or attending public funerals, or viewing the corpse of the unfortunate. The expense attendant upon the services of a medical man are so great that in most cases the employment of a doctor is impossible.

The official of the Provincial board having reached the infected district and finding the foregoing to be briefly the condition of affairs, and ascertained the extent of country to be traversed; and having located the townships where municipal councils exist, what are his duties? Two-fold: (a) to protect the living, preventative; and (b) to succor the diseased, curative. The fulfilment of the first requires prompt action, personal supervision, and persuasive speech. To his assistance he summons the local board of health, should such exist, failing this, the Reeve and other officers of the municipality, who immediately appoint a board of health. He (the inspector) must direct the action of the local authorities, pointing out its duties and responsibilities regarding the maintenance of perfect isolation of the households infected, and provisioning of the families whilst quarantined. For these purposes the board must appoint an adequate number of sanitary police, who must be under the control of the medical inspector and should be carefully instructed in their duties by him; and an ever watchful eye should be over their actions. Failing the existence, however, of any local authorities to assist him, the inspector's duties are more arduous, and he must act in the case himself. With the local board put in action, and their sanitary police

preventing the infected from becoming a further danger to the community, there will have returned a feeling of confidence which will increase as house to house visitation progresses. This must be thorough and systematic, each member of the family coming personally for examination. He must take nothing for granted, for in these districts the dread of being found with the disease, and therefore placed in isolation, will, I have found, cause some to avoid the officer. For future reference I would advise a list being kept of houses visited, the names recorded of persons examined, and notes made of cases where necessary, also the school noted which the children attend.

Where the disease is found to be present the inspector's professional services will be required. As in this paper treatment would be out of place, it will not be touched upon. Suffice to say that he must give his directions as plain and simple as possible, and in writing; impress upon all the importance of a faithful carrying out of those instructions, for it will be impossible perhaps to see the cases for some days. There is no "ringing up by telephone." The head of the house must be instructed as to his duties to the healthy members of his own family, as also to his neighbors. While quarantined assure him his household wants will be attended to by the sanitary policeman, and that so long as he and his act according to instructions all will go well; and they are thereby materially assisting in the stopping of the epidemic.

What few schools are in the district should be closed until such time as the inspector has satisfied himself in the manner indicated that the households of the individual scholars thereof are free from diphtheria; it is better to have pupils lose a few weeks' tuition than that even a single child should contract the disease.

The adoption of these measures regarding isolation of households and their surveillance by sanitary police at suitable points will result in the almost immediate stoppage of the epidemic—the police control of the several houses to which the disease is confined must not be permitted to flag as the patients progress to complete convalescence; this is very apt to be the case, and the inspector must be more vigilant than ever in keeping his sanitary police up to their duties.

The foregoing are, briefly, the points to be observed in dealing with an epidemic of this disease up to the point where convalescence of the patients is complete—to many they may seem easy of accomplishment but when you consider the miles to be travelled, the scattered position of the settlers and the double duties of the official, you will, I think, acknowledge his position is no light one. But now, at the end of the period of isolation, new work awaits him. Disinfection has to be carried out as thoroughly as possible; unlike the more fortunate health officer of our urban districts, he cannot delegate the work to a competent official who will thoroughly do it, removing all wearing apparel, bedding, etc., to the sterilizer and disinfecting premises. The houses in which most of the cases in these districts are found to consist of one to three apartments,

seldom more; but imperfectly partitioned so that for all practical purposes it may be considered that the contagion has been able to gain access to all parts of the house; fumigation is impossible, for the inmates have no where else to live while it is being done. A good method to pursue is to first burn what invaluable articles have been used by the patients in the way of old clothing, straw bedding, etc.; all other wearing apparel and bedding soak for 12 hours in a solution of corrosive sublimate 1 in 1,000, subsequently boil; and wash as usual the interior of the house, walls, ceiling, and floor, and all articles of furniture and kitchen and bedroom utensils should be scrubbed with soap and boiling water, afterwards washing with a 1 in 500 acid solution of the bichloride, with of course a subsequent rinsing of the kitchen utensils in boiling water; if possible the interior of the house is lime washed subsequently. Such has been my custom since 1889, and if confirmation is necessary as to the effectiveness of the practice regarding the disinfecting of walls and ceiling I would refer you to a series of experiments conducted by [1] Drs. Laveran and Vaillard and reported to the Academy of Medicine, Paris, as recently as July 24 last. These experimenters found that the use of soap (green) and boiling water upon the walls of apartments, followed by an acid solution of corrosive sublimate 1 per 500, acid to prevent the formation of an insoluble albuminate of mercury, thereby acting as a coating which prevents the penetration of the disinfectant. They found this process "much more satisfactory" than when a spray was used. Dr. Laveran found that the microbes are not destroyed by the spray even when applied at a distance of 4 centimetres, and he adds he "would not consider himself safe in a room the walls of which had simply been subjected to the application of a jet of an antiseptic liquid."

A few words may not be out of place treating of the disease in lumber camps and similar places. If you are fortunate enough to see the first case, the man can be removed to some out-building improvised as a hospital with the result that no further cases occur, but when a number of men have become infected use the old house as the infectious hospital and at once have erected a new, to which the healthy men can be removed as soon as blankets, etc., have been disinfected, and to which those recovered may be removed when their period of quarantine is up; when no longer required the hospital can be burned down, this being the only sure way of being rid of the infection.

The question as to the length of time isolation should be enforced is one that cannot be fixed by exact dates, certainly as long as the Klebs-Loeffler bacillius is to be found in the oral or nasal passages it is not permissible to raise quarantine, and we know that its presence has been demonstrated a month after the disappearance of the false membrane and in a few cases at longer periods. Professor Loeffler at the recent meeting of the International Congress of Hygiene and Demography at Buda Pesth, reporting on behalf of the German Committee of Investigation, stated "that the

[1] The Medical Week, Vol. 2, No. 30, 1894.

bacillus might disappear with the eruptions but might remain for months in a condition of active virulence in the throat of infected subjects." —*The Lancet*, Sept. 8, 1894. My custom has been to keep the patients isolated for at least 28 days from the commencement of the attack, and I have had but few whom it was necessary to detain longer, the disinfecting spray of perchloride of mercury being used daily up to and sometimes beyond the time of enforced isolation.

Great inconvenience is found in all rural districts from the want of some central place—a temporary hospital to which infectious cases could be removed—thereby relieving the medical officer of long tedious journeys, and in exchange for imperfect attendance giving the patients good care and daily medical visits, and as a result, a decrease in the death rate and a lessening in the number of cases in each household. The cost to the municipality would be perhaps slightly greater if some such central hospital were made a permanent institution for all infectious diseases, but the danger of these diseases becoming epidemic would be almost nil; possibly the provincial and state governments could be prevailed upon by their Boards of Health to establish a few such hospitals in the new settlements whilst the more densely populated municipalities could maintain such at their own cost.

To those who are accustomed to meet this disease provided with all that a medical officer of health should have,—by this I mean a system of notification, sanitary police well trained in their duties, a central disinfecting station with suitable apparatus, and lastly an isolation hospital. But little of the foregoing remarks will be of interest but to those who are called upon to manage epidemics of diphtheria or perhaps other infectious diseases in rural districts there will, I trust, be found some points worthy of more than passing notice. These epidemics necessarily become more frequent as intercourse with urban districts increases, and as a rule the death rate is much higher, principally, I believe, from lack of medical attendance and careful nursing.

The medical officer in these cases must exercise a personal supervision not only over his patients but personally superintend the carrying out of all orders, for upon the thoroughness of the work depends to a very large extent the prevention of further outbreaks in the district.

PRACTICAL DIFFICULTIES OF MEDICAL HEALTH OFFICERS AND PHYSICIANS IN DEALING WITH SUSPECTED CASES OF DIPHTHERIA.[1]

By P. H. BRYCE, M. A., M. D.,

Toronto, Canada, Secretary of the Provincial Board of Health of Ontario.

Gentlemen of the Association: It is well within the recollection of most whom I address that it is not more than ten years since scientific investigation gave us any actual idea of the immediate cause of the disease known as diphtheria. At that time even its contagiousness was disputed by many; and while medical practitioners having experience with the disease had noted its special incidence in certain localities and still more in certain dwellings, yet the cause was by most supposed to be due to local unsanitary conditions wherein the decomposition of organic matter, whether animal or vegetable, in cellars, sewers, etc., was supposed to exert a causative influence. While to-day such conditions are readily acknowledged to exert influences favorable to the occurrence of the disease, yet actual observers of this as of other zymotic diseases give such influences the secondary place, and speak of them as exciting causes rather than the immediate cause.

The part which the presence of decomposing organic matter plays in the dissemination of the disease must not, however, in my opinion, be for a moment lost sight of, as otherwise the working sanitarian, *i. e.*, the executive health officer, will often be robbed of an argument of the greatest value in his efforts to suppress outbreaks of the disease, or to supply a fairly satisfactory explanation of the occurrence of so called sporadic cases.

Before discussing further, however, the importance of decomposing organic matter in favoring outbreaks of diphtheria, it will be well for us to make some observations on what we call the immediate cause of the disease. Within the two or three years after the announcement by Loeffler of his discovery of the bacillus which he asserted to be the true cause of diphtheria, pathologists in many laboratories published the results of their researches made along the lines laid down by him, and many asserted with equal positiveness that Loeffler's bacillus, while certainly present in many cases of diphtheria, was yet by no means necessary to the appearance of the disease, *i. e.*, of a diphtherial exudation on the mucous membrane of the pharynx. I need only recall on this point the work of Professor Prudden, of the College of Physicians and Surgeons of New York, on the streptococcus of diphtheria.

[1]Read at the Montreal Meeting of the American Public Health Association.

Without dwelling further on the results of other investigators it need only be said that with the multiplied labors of many bacteriologists we now know that the mucous membranes of the mouth and air passages having air to the amount of over eleven cubic metres in twenty-four hours passing over them must necessarily become the receptacle of all floating particles existing in this volume of the atmosphere.

When it is further remembered that microbes, according to various experimenters, will not rise from moist surfaces, and that air expelled from the throat through a sterilized tube is incapable of inoculating a culture medium of beef broth, it is apparent that the mouth with its mucous membranes maintained at a temperature of 38.4 C. must act very similarly to a culture medium in which microbes from dust, whether in air or on food, begin the struggle for existence; those forms finally triumphing which find the environment most completely in harmony with individual peculiarities and local conditions.

To in some degree illustrate this point the following figures may be given: Air respired by an average man in 24 hours, 11.05 cubic metres. Average number of microbes in cubic metre of air of Paris, France, in 1884, 3,480; in centre of Paris in 1893, 6,040. In new park of Montsouris in 1884, 480; in park clothed with turf and trees, 1893, 275. In ward in Hotel Dieu, 3,250. In air of Paris sewers, 4,070.

In this connection it may be mentioned that Miquel has found that while in winter the external air of Paris contained moulds to bacteria in proportions of about 6 to 1, yet the ratio in the air of Hotel Dieu was, moulds 1 to 20 bacteria.

Bacteria in mouth and nasal passages:

Von Besser found on nasal mucous membrane 81 cases;
  Diplococcus pneumoniae 14 times;
  Staphylococcus pyocyaneus 14 times;
  Streptococcus pyogenes 7 times;
  Bacillus Friedlanderi 2 times.
Black, in 10 healthy persons, found,—
  Staphylococcus pyocyaneus 7 times;
  " pyoalbus 4 times;
  Streptococcus pyogenes, 3 times.

This table, necessarily very incomplete, is enough to illustrate the important point, that both in theory and by observation the transference from the dust of streets, and still more of habitations of numberless living forms, is constantly going on, and therefore it need cause no surprise if every form, capable of overcoming the protective influences present on the respiratory mucous membrane, should from time to time and in different climates, localities, and under different conditions make their presence in the system recognized, owing to the exudative processes resulting in the formation of a so called diphtheritic membrane.

Without referring further to the influences promoting diphtherial exu-

dations, I propose for the purposes of my paper to refer to the results of the most recent experimental work on the subject of the diagnosis of true diphtheria in order that the difficulties experienced in dealing with the disease may be made apparent.

I refer especially to the bacteriological and clinical observations made by MM. Chaillou and Martin, internes of "Hospital des Enfants," Paris, carried on under the direction of Dr. J. Simon of the hospital, and Dr. Roux, of "L' Institut Pasteur."

Reverting to the varieties of microbes found in diphtherial membranes it may be said that the work of Yersin and Roux, published in 1891, indicated with great clearness the importance of the bacteriological examination of diphtheritic membrane in the case of all patients brought to diphtheria hospitals, before their admittance to the wards, from the fear that such patients if not affected with the Loeffler bacillus would in the wards be exposed to the contagion.

Since that time attempts more or less systematic have been made to give practical direction to such examinations by urging the measure in private practice. This, however, from causes manifest to all, has been possible only under exceptional circumstances, and everywhere practitioners proceed in the old way of diagnosis by merely clinical signs and symptoms; although, as MM. Chaillou and Martin state in the outset of their paper, published in the July number of "Annales de L' Institut Pasteur," "Les nombreux savants qui ont écrit dans ces derniers temps sur le diagnostic de la diphtherie s' accordent à reconnâitre que dans lés angines blanches, seul l'examen bacteriologique peut fournir un diagnostic certain."

In the complete supervision and study of 200 cases as internes of the hospital (Hôpital des Enfants) they have been able to say that the bacterial diagnosis being made it was then possible with a systematic observation of the clinical signs as of the adenopathies-albuminuria, temperature, pulse, and respiration, etc., to make very accurate prognoses.

From what has already been stated with regard to the dissemination of microbes we shall be prepared for the following results of their work on those points we are at present specially concerned with:

Their examinations included 198 cases in all,—anginas or throat invasions 99, croups or laryngeal 99. Of the anginas they established three divisions,—

Anginas, non-diphtheritic 29; deaths 0.
Anginas, purely diphtheritic 44; deaths 10.
Anginas, diphtheritic with associated forms 26; deaths 18.

Thus more than one fourth of the sore throats were not true diphtheria. It is explained that this work being done in the hospitals in winter the number of throats with non-diphtheritic exudation is less than would be in summer as shown by previous experiments. These non-diphtheritic cases consist principally of coccus forms (single or a diplococcus but not in chains) some disappearing in two or three days, but in half the cases

some membrane, mostly of white points, continued for six days and over. In some of the cases the membrane appeared in the nose or the larynx—in one case necessitating tracheotomy. Essentially these membranes seem more creamy, less adherent and less elastic; but it is practically impossible by the eye to distinguish these from the milder cases of diphtheria. Albumenuria was found in five cases. Five maintained it during the presence of the membrane, and the pulse oscillated with it; nevertheless the general state was good, appetite good, and face keeping its color; while even in the most serious cases the observers did not hesitate to give a good prognosis. One case had the pneumococcus of Frankel, and four cases had the staphyloccus form. In these four cases it was the sole cause of the disease, and the cases were seldom mild.

Other instances of an undetermined bacillus occurred, and 11 cases with a streptococcus, 3 of these supervening in cases with scarlatinal eruption. These cases were not true diphtheria as shown in several ways, although the membrane in its gross appearance was most characteristic—the scarlatinal redness of the throat chiefly making the distinction. Such cases were transferred to the scarlatina wards; and the course of this disease was there exhibited. In 8 of the cases there were streptococci without scarlatina, these having whitish gray membrane adherent to tonsils and surrounding parts; but patchy, and in two instances pultaceous, and having the staphylococcus pyogenes associated with it. Such cases were sufficiently serious. Summing then these up, there were,—

11	cases	with a	coccus.
1	"	"	pneumococcus.
4	"	"	staphylococcus.
2	"	"	coloform bacillus.
11	"	"	streptococcus,

or 29 in all. They found cases presenting for a number of days serious anginas, but which rapidly became ameliorated and were all healed in from 8 to 10 days.

There were 44 pure diphtherias, of which 10 died. Of these 30 were so mild that they had not been recognized as diphtheria without bacteriological examination; while the other 4 were diphtheria from clinical appearances. The first had but little membrane, 8 cases had mere white points like follicular amygdalitis. These increased but little during succeeding days or even rapidly disappeared. While these observers never found the bacillus of diphtheria without some membrane, yet in several instances it was found only after very close examination.

In 15 cases with more membrane the glands were always engorged. Unequal bilateral extension and glandular enlargement of the two sides were characteristic of true diphtheria.

In 13 cases there was no albumenuria; while in 14 severe cases it was present from the outset, and of these 10 died and 4 recovered. In these cases the membrane was grayish white, very adherent and sanguinolent,

and often had extended over all the back of the throat. Albumen was found in every case at an early stage, and persisted till death; while the interrupted pulse was a most significant prognostic, much more so than the temperature.

In the diphtheritic anginas, with other associated bacteria the Loeffler bacillus overgrows in cultures the other forms, and these are got only by numerous repeated isolations on different cultures. Of these there were 26 cases, the chief being the streptococcus growing after 24 hours on the gelatine as distinct fine points. Of 14 of these cases, 13 terminated fatally; although inoculations in guinea pigs with the two forms cultivated separately are not always very virulent. In 3 cases for several days no albumen appeared but did on the sixth or seventh day. In these cases the patients presented the pale faces, the venous-hued lips, the yellow eyes, the fetid breath, the torpor and generally stricken appearance presaging approaching death.

The cases with associated staphylococcus were likewise very fatal, 5 cases in all, and all dying.

A similar history of the variation in the bacteria present is given in the cases of croup discussed in the paper by M. M. Chaillou and Martin.

The authors draw several most important conclusions,—

1. That in order to give a prognosis the knowledge of the microbes associated with the Loeffler bacillus is necessary.

2. That some of these where present, as the coccus, augur a favorable issue to the case, and that others, notably the streptococcus, indicate a grave prognostic.

3. Some seemed to aid the growth of the Klebs-Loeffler bacillus, others to hinder its development.

This summary of work illustrates, I imagine, almost every phase of diphtheria which those of us who have had much to do with the disease have experienced.

The detailed peculiarities of different cases referred to in the extended monograph have one after another seemed to call up memories of cases within my own experience, which, owing to imperfect knowledge at the time, seemed in their varying characters to be inexplicable on the basis of a common cause.

The bacteriological results therein set forth so far as separating non-diphtheritic cases from true diphtheria have been already taken practical advantage of by a number of public health departments, and on this continent I believe New York city was the first to adopt the method by which test tubes with a culture medium are left at certain stations throughout the city, as drug-stores, where physicians can obtain them with instructions as to the manner of inoculating them with membrane, thereafter to forward them to the laboratory of the city health department.

With a view to aiding medical health officers throughout the province to determine with the local physicians the real nature of doubtful cases of the disease, the Provincial Board of Health of Ontario has notified local

boards to forward as per printed instructions by express specimens to the provincial laboratory for examination.

This work has been in operation for only a few months, and too few specimens have as yet been examined to enable us to give an estimate of the average percentage of cases in which the Loeffler bacillus is likely to be present or absent, so as to serve as a standard for the locality.

There are, as pointed out by M. M. Chaillou and Martin, likely to be seasonal differences, and probably different localities, climates, and cities will show variations in the prevalence of one or more of the specific pathogenic forms referred to by different bacteriologists.

The advantages which the precise knowledge of the cause of membranous exudates has given both in the prevention and treatment of diphtheria while considerable, have nevertheless brought into prominence certain points, which are likely if not intelligently weighed, in their practical bearings, to bring perplexities and difficulties to both attending physician and health officer, quite as great as those existing formerly, where acrimonious disputes have arisen as to whether the sore throat was diphtheria or simply amygdalis with exudation.

The advantages which the accurate differentiation of the microbe causative of the exudat in any case brings us are principally,—

1. That within twenty-four hours in the ward annex of an hospital, a scarlatinal sore throat with streptococcus, can be differentiated and be prevented from exposure to the true disease in the diphtheria ward.

2. That similar cases, where simple cocci or diplococci are present, may be kept from exposure to true diphtheria in the general hospital wards.

3. That physicians will be able to arrive at more intelligent conclusions as regards the duration of a case and its prognosis than hitherto has been possible.

4. That an intelligent differentiation of cases suitable for treatment with the antitoxin against the Loeffler bacillus has thereby become possible.

5. That the probable length of infectiousness of any case can in some degree be determined by the form of microbe present in the membrane.

Such progress is notable, and the needs supplied thereby are fully indicated when we study the reports of contagious diseases hospitals. For instance, in the 3,064 scarlet-fever admissions into the North Eastern Metropolitan Asylums Board Hospital, London, England, for 1893, there were,—

(1) .36 per cent. of post scarlatinal diphtheria.

(2) A number, not stated, of cases of scarlatina accompanied in the acute stage with membranous exudation.

(3) Some cases of diphtheria admitted which proved not to be scarlatinal.

It is noteworthy that in the report of Dr. R. A. Birdwood, the superin-

tendent, no mention is made of the bacteriological differentiation of the several forms of throat exudations.

As, however, with every advance in our knowledge, we find that the practical benefits are often limited by unforseen difficulties, we find that these bacteriological results at once bring into prominence the difficulty which a health officer finds in dealing with cases of sore throat. Summed up they are,—

1. That the physician,—being by these recent investigations made aware that at least 25 per cent. of diphtheria cases are not caused by the Loeffler bacillus—or as some would say, are not diphtheria—will naturally hesitate to call a disease probably non-fatal by a name placing it under the ban of the health act.

2. That physicians endeavoring, as has sometimes occurred, to hide cases in the supposed interest of their clients, will conveniently shield themselves behind the assertion that they could not tell, nor any one else, whether the disease is diphtheria or not.

3. That supposing the health officer on investigation finds that the Loeffler bacillus is not present he at once is in doubt as to whether the public health interests demand isolation of the patients, or even if he thinks they do, whether he has legal authority to isolate what is not diphtheria.

4. That even though he isolate such cases as he does true diphtheria, can he maintain the isolation for the length of time, say four weeks, fixed by the best authorities, as necessary for this disease?

5. That assuming he can differentiate between cases, can he with the known serious nature of many cases in which the Loeffler bacillus is not present, afford to treat these as non-infectious, when as a matter of fact they must have been caused by germs carried to the respiratory passage from the air or other medium in the same manner as the Loeffler bacillus.

Personally from the standpoint of an executive officer I recognize most serious difficulties as certain to arise from what all must agree is a notable addition to our knowledge of throat diseases.

I do not at present recognize for working health officers having to deal with sore throat with exudations, any other alternative than to continue to insist on the isolation of all cases of sore throat with exudation; since while occasional instances of admitted hardship in an unnecessary extension of isolation may be inevitable, yet he will on the other hand have avoided the certain and most serious dangers arising from three fourths of the cases which are those of true diphtheria, and will have succeeded as well in limiting these other throat diseases, not wholly free from danger.

The old adage seems here particularly applicable,—"Incidit in Scyllam qui vult vitare Charybdin."

DES INOCULATIONS PREVENTIVES DANS LES MALADIES CONTAGIEUSES.[1]

Par le Dr. J. E. LABERGE, Montreal, Canada.

La virulence est une maladie causée par un virus. La propriété du virus est d'agir à dose très petite, il ne s'affaiblit pas par l'action au contraire il s'exalte, croît et se multiplie, ce qui est le propre de tout être vivant. Ce virus peut se développer dans le corps d'un autre être vivant, y élaborer des prisons pathogènes pour l'animal chez lesquels il s'est développer, et les différents symptômes que l'on observe dans telle ou telle maladie sont l'effet de la toxine sécretée par le microbe.

Puisque ces virus sont des êtres vivants on peut le modifier en les cultivant dans des conditions spéciales, comme le jardinier modifie des plantes par la culture et créé des races. Les bactéries sont des plantes inférieures qu'on peut modifier d'autant plus facilement, qu'elles se multiplient avec une très grande rapidité, et que nous pouvons les mettre dans des conditions de culture bien définies. Aussi arrive-t-il à leur faire perdre leur virulence au moyen de procédés spéciaux. Mais pour que ces modifications soient durables, il faut employer des procédés qui agiront très lentement, plus l'action modificatrice sera lente plus l'atténuation sera durable ; quand une fois les cellules de l'économie ont fait connaissances avec un virus elles en gardent longtemps le souvenir.

Les résultats obtenus jusqu'à ce jour par la vaccination ouvrent un horizon tout nouveau à la thérapeutique préventive des maladies infectieuses.

Pour bien comprendre cette action préventive dans les maladies contagieuses, il faut bien se rendre compte que l'organisme est composé de cellules vivantes et que l'on peut attribuer à ces cellules les mêmes propriétés qu'à l'organisme entier. C'est-à-dire, l'énergie dans la lutte pour l'existence, l'accoutumance aux agents nuisibles ? Mitchnikoff a démontré en effet plusieurs faits qui prouvent qu'une pareille lutte existe entre les cellules et les bactéries. C'est la théorie phagositaire.

L'idée de prévenir les maladies contagieuses par l'inoculation est très ancienne. Au siècle dernier Lady Montague introduisit cette pratique en Angleterre. On donnait alors la maladie virulente elle-même, espérant une maladie bénigne chez la personne inoculée. Les vétérinaires ont depuis longtemps inoculé la péripneumonie contagieuse du gros bétail, dans le but de prévenir cette maladie. Pour cela, ils inoculaient les animaux à l'extrémité de la queue, qui est généralement peu vasculaire, ayant peu de lymphatique, tissu dense et très serré, plus froides que les autres parties du corps. Toutes ces conditions permettaient de retarder la péné-

[1] Read at the Montreal meeting of the American Public Health Association.

tration du virus dans l'économie de manière que l'animal s'habituait petit à petit à son action, et ils obtenaient certains succès.

A Jenner revient l'honneur de la découverte du vaccin en 1796. En effet il a démontré qu'un virus, analogue à celui de la variole, transporté du pis de la vache dans l'organisme humain, est capable de prévenir la variole. Si en 1796 Jenner fit une rencontre de génie, en 1880 Pasteur fit une découverte génie. Et, si grande que fut la découverte de Jenner, elle n'est qu'une observation de hasard, sans fécondité scientifique ultérieure. La découverte de Pasteur, au contraire, c'est le virus mortel lui-même qui sert de point de départ au vaccin, c'est la main de l'homme qui avec des dónnées sûres et certaines fait le vaccin. Ce vaccin peut être préparer par un artifice de laboratoire de manière à suffir à tous les besoins. Les recherches de Pasteur et de ses élèves, Roux, Chamberland, Chauveau, Thuillier, et plusieurs autres, ont ouverts la voie à de nouvelles découvertes qui ont révolutionné presque complètement la médecine.

Les moyens d'atténuer les microbes sont nombreux.

Pasteur emploie l'oxygène comme moyen d'atténuation du virus.

Toussaint avant lui avait atténué le virus en les chauffant à une température de 55 degrés, mais ses résultats étaient tellement peu certains qu'il ne pût faire entrer sa méthode dans la pratique.

Chamberland et Roux atténuent les virus par l'addition de substances antiseptiques, telles que acide phénique, acide sulfurique. Ils ont réussi aussi à conférer l'immunité contre le vibrion septique de Pasteur en injectant après les avoir filtrées des bouillons stérilisés dans lesquels on avait cultivé ce microbe. On atténue encore le virus en le faisant passer par le corps d'un animal refractaire, comme pour le vaccin de la variole ou de la diphtérie.

Fleugge dans un travail paru en 1888 sur l'atténuation des bactéries, distingue deux formes absolument différentes d'atténuation.

1° Une forme produite par la culture successive de la bactérie sur des milieux nutritifs artificiels ou par le passage à travers le corps d'un animal non susceptible.

2° Par l'addition de corps chimiques ou par la chaleur.

Dans le premier cas il s'agit, d'une transformation lente d'une bactérie pathogène parasitaire en un sapophyte, probablement par une espèce de sélection. Dans la seconde forme d'atténuation il s'agit d'une dégénérescence absolue des bactéries, et en effet ces bactéries mises sur milieu de culture montrent une croissance beaucoup plus faible que le microbe virulent lui-même.

Le problème des vaccinations et de l'atténuation des virus fît un pas décisif lorsqu'il fut démontré que les bactéries étaient la cause essentielle de la virulence, lorsqu'on pût cultiver les bactéries d'un liquide virulent, étudier la façon dont ils s'affaiblissaient suivant les modification du milieu nutritif, suivant les conditions de température ou d'aération. Alors il vient à l'esprit de Pasteur d'employer ces cultures comme vaccin.

Je crois, messieurs, que la meilleure preuve que nous ayons de l'utilité de la vaccination dans les maladies contagieuses est toute entière dans les admirables expériences que ce grand Maître a faite, lesquels expériences ont été couronnées toujours de si beaux succès. Vous me permettez donc d'énumérer aussi brièvement que possible ces admirables découvertes.

En 1880 M. Pasteur, étudiant le choléra des poules, ensemença un nombre de fois considérable le microbe de cette maladie. En le faisant passer de culture en culture il remarqua qu'on pouvait faire cet ensemencement aussi souvent que l'on voulait, des centaines et des centaines de fois, le dernier liquide ensemencé était aussi virulent que le premier pourvu, toutefois, que les ensemencements aient été faits à des intervalles égaux. Mais si, au lieu de faire ces ensemencements à toutes les 24 heures par exemple, on laisse un intervalle entre chaque culture de plusieurs jours, de plusieurs semaines, de plusieurs mois, il s'opère un changement dans la culture. Ce changement, qui est variable avec la durée de l'intervalle entre chaque culture, s'accuse par un affaiblissement de la virulence.

De telle sorte, que si une serie de culture du choléra des poules faite à intervalles égaux, disons de 24 heures chacune, tue 20 poules sur 20 inoculées, une culture, qui aura attendu trois mois par exemple, dans un tube bouché avec une bourre de coton pour permettre l'entrée de l'air pur, ne donnera qu'une légère maladie aux poules et de plus ces poules pourront être inoculées sans danger avec une culture qui sera mortelle pour les animaux qui n'auront pas été vaccinés.

Quel est l'agent qui intervient pour modifier cette culture? Cet agent, c'est l'oxygène de l'air, et en voici la preuve. Si, au lieu de fermer le tube qui contient les cultures avec une bourre de coton, on le ferme à la lampe, de manière à empêcher l'oxygène de l'air de pénétrer dans ce tube, au bout de deux ou trois mois cette culture sera toute aussi virulente que si elle était ensemencé que depuis 24 heures.

Peu de temps après cette découverte d'une importance doctrinale qu'il est facile à comprendre, Messieurs Pasteur et Chamberland, constatant que le charbon ne recidive pas, pensèrent à modifier cette bactérie au moyen de cultures spéciales.

On savait que la bactérie charbonneuse est peu résistante, mais que la spore est d'une très grande résistance; d'où la nécessité de trouver le moyen de modifier la bactérie avant qu'elle donne de spore. C'est ce que Messieurs Pasteur, Chamberland, et Roux obtinrent en chauffant cette bactérie à 42,°5 centigrades. Ils prirent un goutte de sang charbonneux, l'ensemencèrent dans du bouillon, et mirent cette culture à une chaleur constante de 42,°5 centigrades. C'est la condition essentielle pour empêcher la formation des spores. Après trois semaines de séjour à cette température cette culture tue les animaux sensibles, mais ne tue pas le bœuf qui est peu sensible. S'ils prolongent l'exposition à la chaleur cette culture devient inoffensive pour tous les animaux. Cette

culture atténué peut se cultiver et donner naissance à une autre culture jouissant des mêmes propriétés que la culture mère. C'est encore l'action de l'air qui modifie la culture, l'oxygène de la température de 42,°5 centigrades, empêche seulement la formation des spores. Ayant obtenu ce vaccin voici comment ces messieurs procédent pour vacciner. Ils inoculent d'abord un vaccin très léger, c'est-à-dire ayant été exposé à l'air pendant plusieurs semaines, cinq ou six semaines ; puis douze jours après ils inoculent un vaccin moins atténué, qui n'affecte pas la santé de l'animal protégé qu'il est par la première inoculation.

Il y a d'autres procédés d'atténuation, mais pour que cette atténuation soit efficace, il faut que les actions modificatrices soient lentes et continues. Conditions qui sont remplies dans le précédent procédé. On peut rendre sa virulence première au microbe et même la dépasser, en faisant passer successivement cette culture d'un animal moins fort à un animal plus fort et plus résistant.

Depuis l'année 1881 en France on inocule presque tous les animaux, les résultats sont excellents, le charbon disparaît petit à petit, et finira par disparaître complètement. M. Koch, qui le premier a cultivé la bactérie charbonneuse, s'est élevé contre cette pratique, mais les résultats obtenus en France et même en Allemagne donnent amplement raison à la découverte de Pasteur.

En 1881 dans les troupeaux dont la moitié avaient été vaccinée et l'autre moitié non vaccinée, tous les animaux continuant à vivre ensemble, la mortalité par le charbon fut, sur les animaux vaccinés, dix fois plus faible que sur les animaux non vaccinés. Une mortalité sur sept cent quarante moutons au lieu de un sur soixante et dix-huit moutons. Et sur les vaches et les bœufs la mortalité fut quatorze fois plus faible sur les animaux vaccinés, 1 sur 1254 au lieu de 1 sur 88 sur les non vaccinés.

La durée de l'immunité depasse généralement une année, mais il vaut mieux vacciner tous les ans. Si l'immunité n'est pas constante il ne faut pas conclure de quelques insuccès que la méthode n'est bonne, les résultats obtenus sont là pour démontrer le contraire, cela prouve tout au plus qu'elle n'est pas parfaite, que les inoculations sont quelquefois pratiquées dans de mauvaises conditions, par exemple l'animal étant déjà malade du charbon.

En 1882 M. Pasteur alla étudier dans le département de Vaucluse (France) le rouget des porcs. Il eut recours, comme pour le charbon, à l'oxygène pour atténuer la virulence de ce microbe, après avoir reconnu que cette maladie est dûe à un microbe. Il vaccina une certaine quantité de porcs, quelques mois après, en septembre, tandis que le rouget sévissait partout dans le canton, pas un vacciné n'était atteint ils étaient tous très bien portant.

Bien souvent M. Pasteur avait été frappé, sinou de l'opposition, du moins de la prudente réserve de certains médecins dans l'examen de sa doctrine. Pour triompher de ces résistances il fallait donc, après les

grandes expériences du charbon, s'attaquer à une maladie qui fut commune à l'homme et aux animaux. Une maladie où l'expérimentation, la seule mais la grande force de M. Pasteur, fut souveraine. La rage offrait tous ces avantages. Il commença ses premières expériences sur cette maladie le 10 décembre 1880. Il découvrit que la rage est une malade l'ancephale, que le microbe qui cause cette maladie cultive dans les centre nerveux. Il ensemença directement la substance cérébrale d'un chien enragé dans le cerveau d'un chien trepanné, et celui-ci meurt de la rage au bout d'un temps plus ou moins long. Il constata en outre que la rage apparaissait d'autant plus rapidement que l'inoculation se faisait plus près des centres nerveux ou dans les centres nerveux eux-mêmes. M. Pasteur n'a jamais pu cultiver le microbe de la rage en dehors de l'organisme, il n'a jamais pu l'isoler et depuis aucune tentative de ce genre n'a réussit. M. Pasteur, ne pouvant avoir recours aux méthodes ingénieuses qui lui avaient si bien réussi pour le vaccin du choléra des poules et du charbon, tourna la difficulté et à défaut de flacon de culture le corps des animaux lui servit de milieu où le virus rabique put s'atténuer ou s'exalter. A la mort d'un chien enragé M. Pasteur fit l'autopsie, trepanna, et prenant une parcelle de la moëlle rabique d'un lapin et lui inocula sous la dure mère ce fragment de moëlle. Le lapin mourut de la rage après 15 jours d'inoculation. En inoculant le virus de ce premier lapin à un second puis à un troisième et ainsi de suite par ce même mode de trépanation, il se manifesta bientôt chez ces lapins une tendance de plus en plus accusé dans la diminution de la durée d'incubation de la rage. Après un nombre considérable de passage de lapin à lapin il en vient à avoir un virus d'une virulence fixe, la durée de l'incubation étant de sept jours. Il imagina ensuite un mode d'atténuation du virus qui lui réussit à merveille. Il suspendit, dans un de flacon dont l'air était entretenu à l'état sec par des fragments de potasse déposés au fond du vase, des morceaux frais de moëlle de lapins morts de la rage après les sept jours réglementaires d'incubation. La virulence de ces moëlles en dessication se modifia. Plus le temps passait sur ces moëlles plus il agissait jusqu'à éteindre tout à fait la virulence. M. Pasteur délaya alors un peu d'une de ces moëlles dans du bouillon stérilisé et l'inocula avec un seringue de Pravaz sous la peau d'un chien. En commençant par une moëlle vieille de quinze jours et en remontant de moëlle en moëlle jusqu'à une moëlle très virulente placée depuis un jour seulement en flacon. Les chiens soumis à ces inoculations successives devinrent refractaires à la rage. Non seulement ce traitement fut efficace pour les morsures avenir mais il eut un plein succès chez tous ceux qui avaient été mordu avant que le traitement ait été institué ; pourvu toutefois que le temps écoulé entre la morsure et le début du traitement ne fut pas trop long. Le six juillet 1885 M. Pasteur fit ses premières inoculations sur un enfant âgé de neuf ans, qui avait été mordu le quatre juillet à plusieurs reprises par un chien enragé. Ces inoculations eurent un succès complet, et le 27 juillet, neuf

jours après la dernière inoculation, l'enfant rétournait complètement guéri dans sa famille.

Le second malade traité par M. Pasteur était un berger de 15 ans, il vint à Paris six jours après avoir été mordu, il fut complètement guéri par les inoculations. Et depuis combien de personnes mordues par des chiens enragés ont été guéris? Il est vrai la méthode a échoué dans certains cas, mais alors, il faut le dire, le traitement fut institué trop tard.

Les travaux de M. Pasteur sont poursuivis avec l'ardeur en France et à l'étranger par ses élèves.

La pneumonie, qui est considérée comme une maladie contagieuse, a été le sujet d'études très sérieuses. On a réussi à vacciner avec succès des animaux contre la pneumonie, soit avec des cultures dans du bouillon chauffés à 65 centigrades. Soit avec le sérum d'animaux vaccinés. Une opinion très étendue et qui paraît être la plus rationnelle serait que ce sérum agirait en augmentant la force de résistance des leucocythes dans le sang.

La fièvre typhoïde est également étudiée dans cet ordre d'idée. On a réussi à donner la maladie à des animaux de laboratoire en leur inoculant du bacile typhique, puis on a immunisé sur ces animaux en leur inoculant de la toxine typhique atténuée par la chaleur, et le sérum de ces animaux vaccinés est immunisant pour un autre animal, de même le sérum de l'homme en convalescence de fièvre typhoïde serait préventif et thérapeutique pour les animaux.

Des expérimentateurs ont pu vacciner certains animaux de laboratoire contre le choléra asiatique, et M. Ferran a réussi à vacciner l'homme avec certain succès. M. Klemperer se vaccine lui-même avec une culture stérilisée, puis il s'inocule le virus cholérique sans contracter la maladie, et il constate de plus que son sérum est immunisant.

La tuberculose, qui est une maladie éminemment contagieuse, et qui cause de si grands ravages, a attiré l'attention des bacteriologistes. De nombreuses tentatives de vaccination ont été faites dans le but de prévenir ou de guérir cette maladie, mais sans succès. Le seul résultat pratique et important qui soit resté de tous ces travaux c'est que au moyen des inoculations on peut diagnostiquer à bonne heure la tuberculose chez les animaux alors qu'aucun signe ne laisse même soupçonner l'existence de cette maladie. Ce diagnostic est très important à faire chez la vache à cause du lait qui transportera la tuberculose s'il vient d'un animal tuberculeux. Une injection de ¼ de centimètre cube de tuberculine à une vache tuberculeuse donne de suite une élévation considérable de la température, lorsque chez l'animal sain la température reste normale après la même injection. Le même procédé est employé pour le diagnostic précoce de la morve, en se servant de 1-4 de centimètre cube de maléïne commematière à injection. L'animal morveux aura une élévation considérable de la temperature, les ganglions lymphatiques s'engorgeront, etc.

Beaucoup de savants se sont occupés et s'occcupent encore très active-

ment de prévenir la diphtérie, au moyen des injections de toxine diphtéritiques. On a d'abord essayé de donner l'immunité aux animaux, M. Cale Frankel emploi la toxine chauffée à 70 centigrades, qu'il injecte à l'animal, au bout de 14 jours il leur injecte une culture pure de diphtérie et l'animal résiste. M. Behring a plusieurs procédés. Il inocule le bacile diphtéritique puis, quelques heures après, il injecte une solution de trichlorure d'iode. L'animal est malade mais ne meurt pas, et en général au bout de quelques jours il est revenu à la santé, il est immunisé. Mais le meilleur procédé est le suivant : on prend de la liqueur de Gram. (Iode 1 gramme, Iode Pot 2 grammes, eau 300 grammes) que l'on mêle à de la toxine diphtérique. On injecte ainsi par de petites quantités que l'on augmente peu à peu. Ensuite on peut injecter à l'animal cultures très virulentes et il est immunisé.

On vaccine avec succès l'animal contre le charbon symptomatique. On obtient ce vaccin en chauffant des virus à sec à une température de 105 centigrades pour une première injection et 85 centigrades pour une seconde injection.

On peut aussi vacciner avec succès contre le tétanos. On obtient ce vaccin soit en faisant chauffer une culture tétanique, soit en mélangent la toxine avec la liqueur de Gram. Soit en employant comme vaccin le sérum d'un animal vacciné. Malheureusement si on peut empêcher le tétanos d'évoluer chez un animal on n'a jamais pu trouver le moyen de le combattre efficacement ces maladies par des injections une fois qu'elles sont établies.

Voilà des expériences et des résultats, s'ils ne sont pas parfaits laissent espérer dans un avenir plus ou moins prochain des moyens efficaces pour combattre les maladies contagieuses. La question est à l'étude, et espérons que le succès couronnera les recherches des travailleurs. Il me reste encore, messieurs, à vous parler d'une maladie contagieuse qui est efficacement combattu par la vaccination.

L'utilité de la vaccination comme prophylaxie de la variole est un fait qui est admis aujourd'hui, pour, s'en convaincre, il suffit de constater la disparition graduelle de cette maladie terrible dans les pays où la vaccination est obligatoire. Ainsi en Allemagne, où la vaccination est obligatoire, par 100,000 habitants, la mortalité se chiffre par 0.4 en Suisse ; par 0.8 dans la France, où la vaccination est moins répandue, il y a par 100,000 habitants 35 décès par année. En Autriche, 54 décès par année. Et enfin les terribles ravages que fait une épidémie de variole dans les pays où l'on ne vaccine pas du tout sont trop notoires pour être inconnus. La vaccination ne préserve pas toujours de la variole, et il faudrait pratiquer la vaccination au moins tous les quinze ans. Ne serait-il pas préférable de chercher à atténuer le virus de la variole en employant le même procédé que M. Pasteur a employé pour obtenir le vaccin du choléra des poules, ou tout autre procédé qui donnerait un vaccin d'une force déterminée inoculant d'abord un vaccin très faible, et au bout de quelques jours

inoculer un vaccin plus fort. Nous aurions ainsi peutêtre une immunité plus complète et certainement moins empirique. Car on ne connait pas la force du vaccin que l'on inocule, quelquefois on inocule un vaccin très faible et d'autre fois on peut inoculer un vaccin peu atténué ; dans le premier cas il préservera peu ou pas du tout de la variole, dans le second cas en donnant un vaccin très fort on peut donner une maladie plus ou moins sérieuse à la personne que l'on a vaccinée. Voilà une question, messieurs, que je crois devoir signaler à votre attention.

Comme vous le voyez, messieurs, la question d'inoculation comme moyen préventif des maladies contagieuses est de la plus haute importance, et je suis heureux d'avoir traité cette question devant ceux qui se sont imposé la mission de chercher les rapports sanitaires de l'homme avec le monde extérieure et des moyens de faire contribuer ces rapports à la habilité dé l'individu et de l'espèce.

Jusqu'ici cette pratique ne s'est pas généralisée à l'homme, mais il faut bien pensée que cette science est dans la première enfance et qu'il y a à peine quelques années cette question n'était même pas soupçonnée. C'est en considérant les progrès qu'à fait cette étude en si peu de temps qu'on peut espérer beaucoup de la pratique des inoculations comme moyen preventif des maladies contagieuses.

DISCUSSION ON THE FOREGOING GROUP OF THREE PAPERS.

Dr. Felix Formento, of Louisiana.—Dr. Bryce's paper impressed me very much. Leaving aside the scientific distinctions made between the different microbes of diphtheria, it is our duty as health officers to consider all cases in which the Klebs-Loeffler bacillus has been found as true diphtheria and treat them as such, and give to others in which a bacillus has not been found the benefit of the doubt, placing them among the infectious diseases and requiring that they be reported to boards of health, the same as membranous laryngitis in which the true diphtheria bacillus is not always found, considering them equally as dangerous from a sanitary point of view as diphtheria, and treating them in the same manner.

The paper of Dr. Laberge was an admirable one. It was scientific and very interesting, and I am sure if all of the members could have understood it in the language in which it was read (French), they would have appreciated it. It opens up a broad field, namely, the prevention of disease in the future, also the cure of disease by methods of inoculation with modified and attenuated virus or blood serum. This will be largely the work of the future. We shall strive to prevent diseases of a formidable character with which heretofore we have been perfectly helpless. Personally, I desire to thank the gentlemen for their excellent and instructive papers.

Dr. P. H. Bryce, of Canada.—I think it would be unfortunate if the practical question which I raised in my paper should not be discussed by the members of this Association. There is no disease in the northern part of our continent in the character of a pest that is so great as diphtheria. There are certain difficulties which health officers must discuss with one another from all standpoints in order to properly guide them along lines that will stand scrutiny from a critical public.

Dr. John T. Nagle, of New York.—The health department of the city of New York has been making strenuous efforts to stamp out diphtheria, which is the most formidable contagious disease it has to deal with, and with this end in view it has instructed the bacteriological division to examine gratuitously the cultures furnished it by physicians who attend suspected cases of diphtheria. If the medical attendant is too busy or desires that the health department make the culture, it will accede to his wishes and will send a medical inspector to make the culture, and will as speedily as possible, after the examination, notify him of the result.

Many cases which the medical attendants believed to be croup turned out to be diphtheria, and a number of cases which medical attendants believed to be diphtheria, upon investigation were found to have no diphtheria bacilli. Tubes and directions for making cultures are furnished free by the board of health, and are to be found at convenient designated places throughout the city by physicians, and the board of health will furnish by mail the result of the examination within twenty-four hours thereafter.

Dr. Cyrus Edson, medical commissioner of the board of health of New York city, has great faith in the anti-toxine treatment of diphtheria, and remarks as follows:

"The new anti-toxine treatment for diphtheria which has been worked out in the Koch Institute for Infectious Diseases, in Berlin, promises to be one of the most important discoveries of modern medicine, and so far as can be judged from the data at hand will afford us means for not only protecting persons from diphtheria who have been exposed to the disease, but also a certain means for the cure of the disease when cases are subjected to the treatment in the early stages.

"One of the most important and significant features of the treatment depends upon the absolutely innocuous character of the remedy, it having apparently no influence either favorable or unfavorable in health or disease, excepting as to its power of neutralizing the poison of diphtheria; so, while it has enormous capacity

for good, its use is absolutely devoid of danger. The treatment is based upon the following observations:

"(1) In diphtheria death, as a rule, is due to the poisoning by a chemical substance (a 'toxine') produced by the diphtheria bacillus in the throat and absorbed by the system from the throat.

"(2) A certain degree of immunity which is temporary only is afforded by one attack of diphtheria, and this immunity is the result of an acquired tolerance to the 'toxine.' This applies to both animals and man.

"(3) If large animals, such as horses, cows, goats, etc., are inoculated with minute but increasing quantities of the 'toxine' as derived from cultures of the diphtheria bacillus, they become gradually tolerant to its poisonous action, and will withstand the introduction of larger and larger quantities through the immunity which is acquired from the smaller doses.

"(4) The immunity thus produced is the result of the development in the blood of some substance (anti-toxine) which has the power of neutralizing the poison (toxine) produced in diphtheria, and in animals which have been highly immunized (*i. e.*, capable of withstanding very large doses of the toxine through repeated inoculation of doses minute but constantly increasing in size) the blood at last acquires the power of neutralizing very large, even fatal, quantities of the 'toxine.'

"(5) When animals have been immunized, blood is withdrawn from the circulation in quantities varying with the size of the animal, and is employed through injections underneath the skin for the treatment of cases of diphtheria, and the anti-toxine thus introduced neutralizes the toxine absorbed into the circulation of the sick person from the throat, and thus renders them artificially insusceptible to its action.

"By this method it is apparently possible to protect any person from the contraction of diphtheria when they have been exposed to the disease and infected, if the symptoms have not yet appeared, and also to cure nearly one hundred per cent. of cases where patients are treated in the early periods of the disease. Unfortunately, however, for the rapid and general use of this substance for the treatment of diphtheria, its production requires the constant surveillance of skilled and trained men, a comparatively long period (often four to six months) is necessary to render animals immune to the disease so that their blood can be employed for the treatment, and, finally, when thus rendered immune they can furnish only sufficient blood, as a rule, to treat a comparatively small number of cases; therefore, the production of the substance must necessarily be costly, and it can only be produced in sufficient quantities and be placed at the disposal of poor people by municipal and state sanitary authorities."

Dr. A. W. Suiter, of New York.—As supplementary to the report just made, I would call attention to a proposition which has recently been made in the city of New York, of which I have the honor to be the author. At the annual meeting in February last, I was appointed to organize a discussion on the subject of diphtheria, and I then took occasion to call attention to the fact that in New York and some other places bacteriological diagnoses were being made of diphtheria. I also called attention to the fact that it was possible, and seemed to me feasible, to organize such a system by the board of health for establishment throughout the state, and in order to ascertain its practicability the conclusion was arrived at that the state should be geographically distributed for this purpose, and that the most remote rural districts could be brought into communication with each of the laboratories and not more than a dozen laboratories would be required throughout the state of New York for that purpose; and the facilities for communication are such that we could easily communicate with these laboratories from the most remote districts. This subject attracted a great deal of attention at the time. This plan is supplementary to that of the New York city board of health. It is one that may be put into operation.

OFFICIAL REPORT OF THE PROCEEDINGS OF THE TWENTY-SECOND ANNUAL MEETING OF THE AMERICAN PUBLIC HEALTH ASSOCIATION

HELD IN

MONTREAL, QUEBEC, SEPTEMBER 25–28, 1894.

TUESDAY, September 25, 1894.

MORNING SESSION—10 O'CLOCK.

The Association convened in the Association Hall, Y. M. C. A. building, and was called to order by the President, Dr. E. P. Lachapelle, of Montreal, at 10 a. m., who said:

LADIES AND GENTLEMEN: It is my most pleasant duty to call this meeting to order and to welcome you all. I hope that your stay in Montreal will be pleasant, and that the papers and discussions of this meeting will not only be interesting and profitable, but fraught with good results. As the formal meeting is to take place this evening, I will not make any extended remarks at this time; but I desire, however, to introduce to you the chairman of the Local Committee of Arrangements, Dr. Robert Craik, of this city.

Dr. Craik welcomed the Association on behalf of the Local Committee of Arrangements. He announced that the committee would entertain the Association as follows: On Wednesday afternoon, an excursion down the Lachine Rapids; on Thursday evening, a reception at McGill University; on Friday afternoon, a trip to Grosse Isle (over two hundred miles down the St. Lawrence river), with a stop over at Quebec, and returning to Montreal Sunday morning.

The Secretary reported from the Executive Committee over one hundred and fifty applications for membership, and the applicants were elected members of the Association.

DR. ALBERT L. GIHON.—Before we proceed to the reading of papers, I have a resolution to offer which I think will be acceptable. If there is any pride we have in this Association, it is that it is international in character. There are a number of gentlemen here from over the border, and others who have joined us on this side of the water. I am glad that we have some of our Mexican members present; but our first vice-president, Dr. M. Carmona y Valle, Dr. Eduardo Licéaga, Dr. Domingo Orvañanos, and other Mexican colleagues, are absent, owing to some sickness or indisposition in their families; I therefore desire to offer the following resolution, and move that the secretary telegraph it to Mexico:

Resolved, That the American Public Health Association, in session in Montreal, regrets the enforced absence of its first vice-president, Dr. Carmona y Valle, and its late vice-president, Dr. Licéaga, and Dr. Orvañanos and its other Mexican colleagues, and sends them its fraternal greetings, good wishes, and hopes that we shall see them at the next annual meeting.

Dr. Frederick Montizambert.—I desire to second the resolution, and do so with great pleasure. Inasmuch as Dr. Gihon has alluded to the international nature of our Association, it is fitting that the resolution should be seconded by a representative from Canada.

The resolution was unanimously adopted, and the secretary instructed to telegraph the same to Mexico.

The reading of papers was proceeded with, and the first paper contributed was by Dr. G. H. F. Nuttall, of Baltimore, entitled "Hygienic Notes Made on a Short Journey Through Italy in 1894," which was read by Dr. Gihon in the absence of the author.

Dr. Benjamin Lee, of Philadelphia, followed with a paper on "The Cart Before the Horse."

At this juncture a motion was made and carried that all the papers pertaining to water supply be read before being discussed.

Dr. Wyatt Johnston, of Montreal, read a paper entitled "Observations upon Sedimentation in Water."

Dr. A. N. Bell, of Brooklyn, read a paper on "The Long Island Water Basin—Brooklyn's Reservoir."

Dr. Frank T. Shutt, of Ottawa, Canada, followed with a paper entitled "The Water of our Farm Homesteads."

"Sand Filtration of Water, with Especial Reference to Recent Results Obtained at Lawrence, Massachusetts," was the title of a paper read by Mr. George W. Fuller, of Lawrence.

Mr. E. B. Shuttleworth, of Toronto, presented a paper entitled "Some Deductions From Bacteriological Work on the Water of Lake Ontario," which was read by Mr. Fuller in the absence of the author.

On motion, the Association adjourned until 2 : 30 p. m.

AFTERNOON SESSION—2:30 O'CLOCK.

The Association reassembled at 2 : 30 p. m., and was called to order by the president.

The first thing in order was the reading of the Report of the Committee on the Pollution of Water Supplies, by Dr. Chas. Smart, of Washington, D. C., chairman.

All the papers read during the morning session including Dr. Smart's report were then discussed jointly.

Dr. Chas. A. Hodgetts, of Toronto, read a paper entitled "Management of Diphtheria Epidemics in Rural Districts."

Dr. Peter H. Bryce, of Toronto, followed with a paper entitled "Practical Difficulties of Medical Health Officers and Physicians in Dealing with Inspected Cases of Diphtheria."

Dr. J. Ed. Laberge, bacteriologist to the local board of health of Montreal, read a paper in French on "De la Vaccination comme Prophylaxie des Maladies Contagieuses."

Discussion followed.

Dr. Peter H. Bryce.—I move that the paper of Dr. Alfred Brittain entitled "Drainage of Montreal," be read by title and published in the Transactions; also the paper of Dr. Edward Playter, of Ottawa, Canada, entitled "Notes on the Soil Factory in the Development and Prevention of Infectious Diseases."

Carried.

Dr. J. D. Giffith of Kansas City, Mo., read a paper on "Innocuous Transportation of the Dead."

Discussion followed.

Adjourned until 8 p. m.

EVENING SESSION—8 O'CLOCK.

The Association was called to order at 8 p. m. by the president.

The first thing in order was an Address of Welcome by Dr. Robert Craik, chairman of the Local Committee of Arrangements. (See page 16.)

Lieutenant-Governor, J. A. Chapleau, next delivered an Address. He was warmly received. (See page 18.)

Mayor Villeneauve, of Montreal, then delivered an address of welcome on behalf of the city. (See page 21.)

The Honorable L. P. Pelletier, Provincial Secretary, read an Address. (See page. 22.)

Dr. Gregario Mendizabel, of Orizaba, Mexico, briefly addressed the Association in Spanish.

The second vice-president, Dr. J. N. McCormack, of Kentucky, then took the chair, and President Lachapelle delivered the annual presidential address. (See page 5.)

On motion, the Association adjourned until Wednesday morning.

SECOND DAY.

Wednesday, September 26, 1894.

MORNING SESSION—9 O'CLOCK.

The Association met at 10 a. m. and was called to order by the President.

The Secretary presented a report from the Executive Committee, recommending the adoption of the resolution offered by Dr. Probst. Carried. (For resolution see page 83.)

The Executive Committee recommended the creation of a new committee to consist of five persons, on "Steamship and Steamboat Sanitation." Carried.

Several persons were elected to membership in the Association.

The roll of the Advisory Council was called and vacancies filled. It was then decided that the Advisory Council meet on Thursday at 3 : 30 p. m.

Here followed a discussion of the papers on diphtheria.

Dr. E. Gauvreau, Director of the Vaccine Institute, of Ste-Foye, P. Q., read a paper entitled "Culture and Collection of Vaccine Lymph."

Dr. N. E. Wordin, of Bridgeport, Conn., read a paper on "Restriction and Prevention of Tuberculosis."

Dr. F. O. Donahue, of New York City, followed with a contribution entitled "Examination of the Milk Supply for Tuberculosis in the State of New York."

Dr. Paul Paquin, of Missouri, read a paper entitled "Should the Marriage of Consumptives be Discouraged?"

Dr. Henry Sewall, of Denver, Col., read a paper on the "Climatic Segregation of Consumptives."

The President called for the report of the Committee on The Restriction and Prevention of Tuberculosis, Dr. J. N. McCormack, chairman.

Dr. McCormack.—This committee reported last year, and we ask for further time. We now report progress, and ask that the committee be continued for another year. (Request granted.)

(Here followed discussion of the papers on Tuberculosis.)

Adjourned until 8 p. m.

EVENING SESSION.—8 O'CLOCK.

The Association reassembled at 8 p. m., and was called to order by the president.

Dr. Frederick Montizambert, general superintendent of the Canadian quarantine, delivered a lecture on "Quarantine Appliances," which was illustrated by lantern slides.

Dr. J. Chalmers Cameron, of Montreal, read a paper (illustrated) entitled "Some Points in the Hygiene of the Young in Schools."

"Plumbing in Sanitation" was the title of a paper read by Mr. John Mitchell, president of the National Association of Master Plumbers.

Dr. Arthur R. Reynolds, commissioner of health of the city of Chicago, offered the following resolution:

Resolved, That the American Public Health Association, in convention assembled, approve and recommend the enactment of sanitary plumbing and drainage laws in the future construction of all buildings for the better protection of the health of the people.

(Referred to the Executive Committee.)

Dr. T. D. Crothers, of Hartford, Conn., read a paper entitled "Influence of Inebriety on Public Health."

(Discussion followed.)

On motion, the Association adjourned until Thursday morning, 9 :30 o'clock.

THIRD DAY.

MORNING SESSION—10 O'CLOCK.

The Association met at 10 a. m., and was called to order by the president.

The Secretary.—In response to the resolution sent to Mexico by direction of the Association day before yesterday, I have received the following:

Mexico, September 26, 1894.

To the American Public Health Association:

Special circumstances painfully prevented us from meeting you at Montreal. We hope to have the pleasure of shaking hands with you at our next meeting.

Carmona y Valle.
Licéaga.
Orvañanos.

The Treasurer's report was read, and an Auditing Committee appointed by the president, consisting of Drs. J. N. McCormack, Henry T. Bahnson, and C. A. Lindsley.

The secretary read a paper entitled "A Journal of the American Public Health Association."

On motion, it was referred to the Advisory Council for consideration.

Dr. E. R. Campbell, of Vermont, offered the following resolution:

Resolved, That the American Public Health Association, in convention assembled, record its protest against the use of alcoholic liquor as a beverage, especially among the young, believing that such use is attended with great danger to the health of the individual and society.

(Referred to the Executive Committee.)

Dr. George Homan, of St. Louis, offered the following resolution:

Whereas, It is the sense of the American Public Health Association that the pollution of potable waters in America has reached such a point that the national governments should be asked to take cognizance of the matter with the view of devising means of prevention and relief; therefore be it

Resolved, That this Association memorialize the congress of the United States and ask that they shall authorize the appointment of a competent commission, clothed with power to fully investigate the whole subject of the pollution of rivers and lakes by municipal and manufacturing waste, and provided with sufficient means to enable them to conduct the examination in such manner as shall be deemed best, the results of said examination to be published from time to time for the public information.

(Referred to the Executive Committee.)

Dr. Henry Sewall, of Denver, Col., offered the following resolution:

Resolved, That a committee consisting of not more than five members be appointed by the President of the American Public Health Association, to consider the best form of sanatoria for consumptive invalids, and the most favorable locations for the same within the United States, the report of the committee to be made at the meeting of the Association held in 1895.

Dr. Bryce.—I move that the resolution include the sanatoria in Mexico and Canada. Seconded.

Dr. Sewall.—I accept the amendment. Carried. Resolution referred to the Executive Committee.

Dr. Ralph Walsh, of Washington, D. C., contributed a paper entitled "Vaccine and Vaccination."

Dr. G. P. Conn, of Concord, N. H., read the report of the special Committee on Car Sanitation, as chairman.

(Discussion followed.)

Dr. Felix Formento, of New Orleans, read the report of the International Committee on the Prevention of the Spread of Yellow Fever.

(Discussed by Dr. Horlbeck.)

Dr. S. R. Olliphant, of New Orleans, offered the following resolution, which was referred to the Executive Committee:

Resolved, That it is the sense of this Association that federal surveillance, control, or interference with state quarantine, when efficient quarantine service is maintained, is unwarranted and meddlesome; that the test of the efficiency of a quarantine service should be its past record, and the confidence and approval of neighboring states and other quarantine officials; that the solution of the quarantine problem should be left to the local health authorities, to be worked out in accordance with their individual requirements, and all progressive steps encouraged so long as such advances are made within the limits of safety; that the formulation of regulations by the U. S. M. H. S. for the control of state quarantine stations, without conference with the local quarantine officials, is to be deprecated, and can result only in conflict between state and national authorities; that the U. S. M. H. S. has rendered valuable assistance in the way of collecting and disseminating information bearing on quarantinable disease, and that it can become otherwise useful by rendering assistance when called upon.

Dr. M. S. Inglis, of Winnipeg, Man., offered the following resolution, which was also referred to the Executive Committee:

Resolved, That a committee of this Association be appointed by the Executive Committee for the purpose of promoting the collection and distribution of sanitary literature and health by-laws and regulations to the members of this Association, to be known as the Committee on Distribution of Health Regulations and Reports, said committee to have power to make such financial arrangements with members as will cover the cost of such distribution.

Dr. N. E. Wordin, of Bridgeport, Conn., read a paper entitled "Final Disposal of Garbage."

Col. F. W. Morse, of New York, read a paper entitled "The Collection and Disposal of Refuse and Garbage of Large Cities."

Rudolph Hering, C. E., of New York, chairman, read the report of the Committee on Disposal of Garbage and Refuse.

(Discussion followed.)

Dr. W. H. Hingston, of Montreal, contributed a paper entitled "The Influence of the Climate of Canada on Health."

Adjourned.

AFTERNOON SESSION—3 O'CLOCK.

The Association reassembled at 3 p. m., and was called to order by Dr. Albert L. Gihon in the absence of the President and Vice-Presidents.

The first paper read was entitled "The Advisability of Teaching the Rules and Principles of Hygiene in the Primary Schools by means of Object Lessons," by Dr. Jesus E. Monjarás, of San Luis Potosi, Mex.

Dr. Bryce offered the following resolution:

Resolved, That this Association, in view of the difficulties which have been illustrated at this as at other meetings of having the reports of special committees properly discussed, and in the insufficient time given for dealing with the more practical subjects which this Association is concerned in, does hereby instruct the Executive Committee to present some scheme for consideration which will obviate the difficulties above referred to.

(Referred to the Executive Committee.)

Dr. S. Gauthier, of Upton, P. Q., read a paper entitled "The Importance of Teaching Hygiene in Elementary Schools."

Dr. T. D. Reed, of Montreal, followed with a paper on the "Hygiene of Vision in Schools."

Dr. T. M. Brennan, of Montreal, read a paper entitled "A Few Remarks on School Hygiene."

Dr. Andrew Macphail, of Montreal, read a paper entitled "An Epidemic of One Hundred and Twenty Cases of Paralysis in Children."

Dr. L. Laberge, of Montreal, followed with a paper entitled "The Advances of Public Health in the City of Montreal."

Dr. A. A. Foucher read a paper entitled "Myopia in Its Relation to School Hygiene."

(Discussion followed.)

Dr. T. D. Crothers, of Hartford, Conn., offered the following resolution, which was referred to the Executive Committee:

WHEREAS, The use of alcohols as beverages are attracting great attention among all classes, and are obviously the source of many grave disorders that are untimely associated with questions of public health, therefore be it

Resolved, That a committee of three be appointed by the chair to examine and report at the next meeting, on the extent of this evil, and the possible means of prevention which appear practical from a sanitary point of view.

Dr. G. Mendizabal, of Orizaba, Mex., read a paper entitled "Some Brief Considerations of Yellow-Fever in Vera Cruz, and Preventive Treatment."

Dr. J. I. Desroches, of Montreal, contributed a paper entitled "Hygiene in Medical Education."

Dr. Samuel W. Abbott, of Wakefield, Mass., read the report of the Committee on Nomenclature of Diseases and Forms of Statistics.

DR. HOLTON.—I move that the report be accepted, and the committee continued. Carried.

On motion, the Association adjourned until Friday, 9:30 a. m.

FOURTH DAY.

FRIDAY, September 28, 1894.

MORNING SESSION.—10 O'CLOCK.

The Association met at 10 a. m., and was called to order by the President.

The first thing in order was the report of the Executive Committee.

THE SECRETARY.—The Executive Committee have considered the resolutions offered yesterday by Dr. Campbell of Vermont, and Dr. Crothers of Connecticut, and offer the following substitute for both:

Resolved, That a special committee of three persons be appointed "On the Abuse of Alcoholic Drinks from a Sanitary Standpoint."

Recommendation adopted.

THE SECRETARY.—The Executive Committee have considered the resolution offered by Dr. Olliphant, of New Orleans, and present as a substitute the following:

Resolved, That in the opinion of this Association quarantine questions being of such importance to all countries on this continent, there should be no enactment and exaction of quarantine regulations in conflict between federal, state, provincial, and local authorities.

DR. ALBERT L. GIHON.—It seems to me that a resolution of that sort is repeating what we all know. There is no use of our passing resolutions which are self-evident facts. We have declared over and over again that we do not advocate any form of legislation which shall conflict with the regulations referred to. It seems to me that we do not gain anything by passing a series of resolutions that amount to nothing but so many words. No one pretends that this Association desires to enforce anything having a sectional, partisan, or hostile character. I therefore move that the resolution be laid upon the table. Carried.

THE SECRETARY.—The Executive Committee have considered the resolution offered by Dr. Horlbeck, and recommend its reference to the Committee on National Legislation.

Recommendation adopted.

THE SECRETARY.—The Executive Committee have considered the resolution offered by Dr. Sewall in relation to sanatoria for consumptives, and recommend that it be referred to the Committee on the Prevention of Tuberculosis.

Recommendation adopted.

REPORT OF THE ADVISORY COUNCIL.

Mr. President.—I have the honor to present in behalf of the Advisory Council the following report. The Council desires to recommend to the Association the following officers for the ensuing year:

President.—Dr. William Bailey, of Kentucky.
First Vice-President.—Dr. Granville P. Conn, of New Hampshire.
Second Vice-President.—Dr. Gregoria Mendizabal, of Orizaba, Mexico.
Secretary.—Dr. Irving A. Watson, of New Hampshire.
Treasurer.—Dr. Henry D. Holton, of Vermont.
Executive Committee.—Dr. Henry I. Bahnson, of North Carolina; Dr. Peter H. Bryce, of Ontario; and Dr. E. P. DeVaux, of North Dakota.

Invitations have been presented for the Association to hold its next meeting in Denver, Colo., Minneapolis, Minn., and Banff Springs, Manitoba.

The Council desires to recommend that the meeting in 1895 be held in Denver, Colo.; to favor the acceptance of an invitation from Davenport, Ia., to stop one day in that city en route to Denver, to inspect the water filtration plant and other interesting sanitary features.

The Association has been invited to hold its meeting in 1896 in the city of Nashville, Tenn. It was voted to endorse the invitation, and to refer it to the next Advisory Council.

The following resolution was adopted:

Resolved. That the question of publishing the Transactions of the Association quarterly be referred to the Executive Committee to arrange for such publication if the scheme be found practicable.

C. O. Probst, *Secretary.*

The report was accepted, and the Secretary was directed to cast a ballot for the Association for the nominees presented by the Advisory Council, and they were declared elected.

The Chair appointed Drs. Montizambert and Gihon a committee to escort the president-elect to the chair, which they did.

The President.—I have the pleasure of introducing to you your newly elected President of this Association, Dr. Bailey, who will address you.

Dr. Bailey.—*Mr. President and Gentlemen of the Association:* Those of you who know me well will have no fear or apprehension that you will be inflicted with a speech. I want, in the simplest and fewest words possible, to express, although inadequately, the feeling, the gratification, the happiness I have in view of the honor that you have conferred upon me. For fifteen years, you will bear me evidence, I have gone in and out of this Association quietly and unobtrusively, without solicitation on my part for office, yet you have seen fit to select me as your President for next year. The only regret is that I am so fully conscious of the faults or weaknesses that shall come to the administration. I cannot hope to rival the administration that goes out at this hour. All I can ask is that you will give to me the cordial, earnest support that you have

given to Dr. Lachapelle. Whatever there is in me in talent shall be devoted to the interests of the Association. (Applause.)

Again thanking you for this distinguished honor, which I am unable to express to you in this, the proudest hour of my life, I would say that "The bridegroom may forget that his bride is made with his wedded wife; the king may forget the crown that upon his head an hour has been; the mother may forget her child so sweetly smiling upon her knee; but I shall remember the Glencairn and all that thou hast done for me." (Loud applause.)

The committees for the ensuing year were announced.

The Auditing Committee, through Dr. McCormack, made the following report:

We have performed the duty assigned to us, and take pleasure in reporting that we have found the books, accounts, and vouchers of the Treasurer correct in every respect, and so arranged that our duties were made very light in our examination.

On motion, the report was adopted.

Dr. Albert L. Gihon offered the following resolution:

Resolved, That the thanks of the American Public Health Association be cordially and earnestly given to His Excellency the lieutenant-governor, and the government of the Province of Quebec; to His Honor M. Villeneuve, mayor, and the municipal council of the city of Montreal; to the Federal government; to the citizens of Montreal; to the authorities of McGill university; to Drs. Craik, Pelletier, and Beaudry, and their associates on the Local Committee of Arrangements; to the members of the press; and lastly, to Montreal's attractive sanitary exhibitions—the ladies—who demonstrated in their own persons the salutary and beatific influence of the Canadian climate, and who contributed so much to the entertainment of the members and those who accompanied them.

The resolution was unanimously adopted.

Dr. Holton.—I would like to offer the following in memoriam of

Dr. John H. Rauch.

Since our last meeting, death has taken, in the person of Dr. John H. Rauch, one of the organizers and promoters of this Association, a man whose love of his fellowmen gave him enthusiastic zeal in the work of sanitation.

We desire to place on record our appreciation of his inestimable work in the field of medical legislation, and in the organization and continued support of this Association. While we mourn the loss of his personal friendship and the admonitions of his wise counsels, the memory of his devoted and courageous efforts in all the departments of his life-work shall be an inspiration to us to take up the work he has left with an increased devotion.

Dr. Montizambert.—As a Canadian, I take the liberty of suggesting that, as a mark of honor to our departed friend, the resolution be received by the Association in silence and standing. Carried.

The resolution was adopted by every member rising to his feet.

A paper by Dr. Nicolas R. de Arellanos, of Mexico, entitled "Quarantine Applied to Small-pox," was read by title.

Dr. M. T. Brennan, of Montreal, read a paper entitled "A Plea for Aseptic Vaccination."

Dr. K. Cameron, of Montreal, followed with a paper entitled "Infection by the Bacillus Pyocyaneus as a Cause of Infant Mortality."

"The Importance of Teaching Hygiene in Elementary Schools," by Dr. S. Gauthier. This paper was called for and passed in the absence of the author.

Dr. J. W. Hughes, of Montreal, read a paper entitled "Evolutionary Developments of Domestic Plumbing during the Past Twenty-Five Years."

The President.—Several papers were left over from yesterday, and if the authors are here now we shall be glad to have them read in the order in which they are called.

Several papers were then called, but the authors were absent. The papers read by title were as follows:

1. "Pure Water *vs.* Purified Water for Public Water Supplies," by Mr. Daniel W. Mead, Rockford, Ill.

2. "Water Supply of Towns," by Dr. A. P. Reid, secretary of the Provincial Board of Health of Nova Scotia.

3. "Notes on the Soil Factor in the Development and Prevention of Infectious Diseases," by Edward Playter, M. D., Ottawa, Canada.

4. "Drainage of Montreal," by Alfred Brittain, Mem. C. S. C. E., assistant-surveyor of the city of Montreal.

5. "Tuberculosis, Its Restriction and Prevention," by John M. O'Donnell, M. D., of Winnipeg, member of the Provincial Board of Health of Manitoba.

6. "Instruction in Hygiene in Schools and Colleges," by C. O. Probst, M. D., secretary of the Ohio State Board of Health.

7. "On Teaching the Principles of Hygiene to the Young," by Geo. G. Groff, M. D., member of the Pennsylvania State Board of Health.

8. "What Organization Ought to be Given to Boards of Health?" by Robert Gayol, C. E., Mexico, Mex.

9. "A Provisional Arrangement of Causes of Death," by Cressy L. Wilbur, M. D., Lansing, Mich.

10. "Difficulty in the Exact Diagnosis of Pathogenic Bacteria," by George Adami, M. D., professor of pathology, McGill university.

11. "Notes Concerning the Nourishment of Children in Their Earliest Infancy, Exclusive of Nursing at the Breast," by E. T. Arthur Simard, M. D., and E. R. Fortier, M. D., professors in Laval university.

12. "Ventilation of Schools," by J. E. Dore, C. E., sanitary engineer of the city of Montreal.

13. "The Burial Ground," by Dr. J. A. Beaudry, inspector of health to the Board of Health of the Province of Quebec.

14. "Sanitary Value of Certain Waters," by Dr. R. F. Ruttan, chemist to McGill university and to the Board of Health of the Province of Quebec.

15. "Prevention of Venereal Diseases," by Dr. Elzéar Pelletier, secretary of the Board of Health of the Province of Quebec.

16. "On the Etiology of Mexican Typhus, a New Contribution," by Dr. Jesus Chico, of Guanajuato, Mex.

17. "Algunas Consideraciones acerca de la Prostitucion," por el Dr. Juan J. R. de Arellanos, Mexico, Mex.

18. "Prevention of the Spread of Yellow-Fever," by Walter Wyman, M. D., supervising surgeon-general of U. S. Marine Hospital Service.

19. "The Free and Liberal Ventilation of Sewers," by Mr. C. Baillargé, F. R. S. C., Quebec, P. Q.

20. "Duree Physiologique du Travail au point de vue Intellectuel et Physique," by Dr. L. E. Fortier, Montreal.

The President.—Before adjourning this Association, it is my pleasant duty to thank you one and all for the kindness with which you have supported me as your presiding officer. I was afraid at the beginning of the meeting that you would make my work a little difficult, but with your forbearance and kindness my duty was easy to perform during the whole meeting.

I also desire to thank you for the good work you have done. We have had a great many papers; some of them were able, and most of them very interesting. In retiring, I am very happy to say that I shall be succeeded by my esteemed and learned *confrère*, Dr. Bailey. I have no doubt that our Association, under his presidency, will continue the good work it has done in the past. (Applause.)

Dr. C. D. Smith, of Portland, Me.—On behalf of the Association, it seems to me that we should in some way reciprocate the kindly remarks which our President has just made, and I therefore move that the thanks of the American Public Health Association be extended to the retiring President, Dr. Lachapelle, for the efficient and courteous manner in which he has discharged the duties of his office, and for his great contribution to the success of this meeting. He has not only exhibited his usual characteristics, but we have also learned that we are the ones who have profited thereby, and we can all return to our homes carrying with us pleasant memories of this meeting, remembering that the success of it was due in no small part to the efficient management of our President. (Applause.) Seconded and carried.

Dr. Mendizabal then addressed the Association in Spanish, his remarks being applauded throughout their delivery.

On motion, the Association adjourned to meet in Denver, Col., in 1895.

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INNOCUOUS TRANSPORTATION OF THE DEAD.[1]

By J. D. GRIFFITH, M. D., Kansas City, Mo.

The age demands a far greater protection of the public health. I am convinced that we owe to the travelling public that greater precautions should be taken in the transportation of the dead body. This assembly has for its motto "Protection from Disease," "an ounce of prevention is worth a pound (yes, ten pounds) of cure." Pepper, in his most estimable work on Theory and Practice of Medicine, gives us a marked evidence of the virulence of a dead body; he says, "In a Normandy village twenty-three years after an epidemic of diphtheria some of the bodies of those who died of the disease were exhumed and an epidemic at once broke out, first among those who opened the grave, and spread from those to many others."

If I am correctly informed, a very severe epidemic of yellow fever in the south was started up by the removal of dead bodies, in 1878, from an old burial ground, where the interment had occurred in 1853.

The state boards of health, throughout the country, and every practitioner of medicine, will limit the attendance if possible, of a funeral when the little one has passed away from measles, scarlet fever, or diphtheria. Health boards throughout the country order the thorough cleansing of a house and rooms after small-pox, measles, or diphtheria.

Our boards of health at once established a quarantine, on account of the ship or train on which there is a case of cholera, typhus, or yellow fever. They look to the little well, and cess pool near it from which your local epidemic of typhoid has arisen. We all now seem to look upon our most forminable enemy, the disease which carries off more of

[1]Read at the Montreal meeting of the Association.

Earth's inhabitants than all plagues and wars combined, consumption, as a disease of contagion and infection, and not heredity.

Until we are educated to the point of the thorough sanitation of cremation, the transportation of dead bodies by the railways is, and always will be, a source of very great danger.

Is ever the source of infection completely and safely stamped out by the preparation of the undertaker? It matters not, seemingly, how tightly the coffin is secured, you will only have to step into a baggage car containing one or two bodies, and you do not have to look, to find out from whence emenates the odor, but you know at once that there is a corpse in the car.

In 1888 the National Association of General Baggage Agents, including most, if not all, of the main carriers of the United States, adopted a schedule of rules and forms to govern the transportation of corpses, to wit:

Rule 1. The transportation of bodies of persons dead of small-pox, Asiatic cholera, typhus fever, or yellow fever, is absolutely forbidden.

Rule 2. The bodies of those who have died of diphtheria, anthrax, scarlet fever, puerperal fever, typhoid fever, erysipelas, measles, and other contagious, infectious, or communicable diseases, must be wrapped in a sheet thoroughly saturated with a solution of bi-chloride of mercury in the proportion of one ounce of the bi-chloride to a gallon of water, and incased in an air-tight zinc, tin, copper, or lead-lined coffin or in an air-tight iron casket, hermetically sealed and all inclosed in a strong, tight, wooden box; or the body must be prepared for shipment, by being wrapped in a sheet and disinfected by a solution of bi-chloride of mercury as above, and placed in a strong coffin or casket, and said coffin or casket incased in a hermetically sealed (soldered) zinc, copper, or tin case, and all enclosed in a strong out-side wooden box, of material not less than one and a half inches thick.

Rule 3. In case of contagious, infectious, or communicable disease, the body must not be accompanied by any articles which have been exposed to the infection of the disease. And in addition to a permit from the board of health, or proper health authorities, station agents will require an affidavit from the shipping undertaker stating how the body has been prepared, and kind of coffin or casket used, which must be in conformity with rule 2.

Rule 4. The bodies of persons dead of disease that are not contagious, infectious, or communicable may be received for transportation to local points in same state, when encased in a sound coffin, or metallic case, and enclosed in a strong wooden box, securely fastened so that it may be safely handled. But when it is proposed to transport them out of the state to an interstate point (unless the time required for transportation from the initial point of destination does not exceed eighteen hours) they must be incased in air-tight zinc, tin, copper, or lead-lined coffin, or an air-tight iron casket, or a strong coffin or casket encased in a hermetically sealed (soldered) zinc, copper, or tin case, and all enclosed in a strong

outside wooden box of material not less then one inch thick. In all cases the box must be provided with four iron chest handles.

RULE 5. Every dead body must be accompanied by a person in charge who must be provided with a ticket marked "Corpse," and a transit permit from the board of health or proper health authority, giving permission for the removal, and showing name of deceased, age, place of death, cause of death, (and if a contagious or infectious nature) the point to which it is to be shipped, medical attendant, and name of undertaker.

RULE 6. The transit permit must be made with a stub, to be retained by the person issuing it; the original permit must accompany the body to destination, and two coupons; the first coupon to be detached by station agent at initial point and sent to the general baggage agent, and second coupon by the last train baggage man. The stub permit and coupons must be numbered, so the one will refer to the other, and on permit will be a space for undertaker's affidavit, to be used in cases in infectious or contagious diseases as required by rules 2 and 3.

RULE 7. The box containing corpse must be plainly marked with paster, showing name of deceased, place of death, cause of death, and point to which it is to be shipped, number of transit permit issued in connection, and name of person in charge of the remains. There must also be a blank space at the bottom of the paster for station agent at the initial point to fill in the form and number of passage ticket, where from, where to, and route to destination of such ticket.

RULE 8. It is intended that no dead body shall be removed which may be the means of spreading disease; therefore, all disinterred bodies, dead from any disease or cause, will be treated as infectious and dangerous to public health, and will not be accepted for transportation, unless said removal has been approved by the state board of health, and the consent of the health authority of the locality to which the corpse is consigned, has first been obtained, and the disinterred remains, enclosed in a hermetically sealed (soldered) zinc, tin, or copper lined coffin or box incased in hermetically sealed (soldered) zinc, tin, or copper cases.

These rules, or course, were made for the protection of the public against dangerous communicable diseases. While self interest, to a very great degree, on the part of the corporations in the protection of their patrons and employés against pestilential danger probably prompted this action, none of us can doubt but that our whole country has been benefited, since most of the state boards of health have not onlya pproved but adopted these rules, as they were originally or with very little modification.

None of you doubt but that dangerous maladies have been spread by handling and shipping the dead body.

Our boards of health throughout the length and breadth of the land have declared consumption (tuberculosis) a disease dangerous to public

NOTE.—The approval of the state board of health for disinterment must be attached to the transit permit.

health. We all admit at once the communicability of diphtheria, scarlet fever, typhoid fever, measles, and small-pox. The boards give explicit directions about funerals of persons dying from any of these latter troubles, the germs producing most of these troubles you have demonstrated. It is only reasonable to suppose that every disease that we are heir to has for its origin some little bug; these are gradually being developed by our pathologists. It is not at all reasonable to say that these microbes do not stop their development and virulence after breathing ceases, and we know full well that their powers of infection are almost unlimited.

Our dead, it matters not to what disease they succumb, are dear to each and every one of us. Let one of them die far away from home of diphtheria, scarlet fever, measles, or any other contagious or infectious disease and the state board of health at once (and with very good reasons) says the body must not be shipped, or if so, it must be wrapped in a strong solution of bi-chloride of mercury (1-125), and packed in a specified casket. I would ask, is there a man within the sound of my voice who thinks that the baggage man is safe under the circumstances? This same should hold good with the consumptives whose bodies, as a rule, are not nearly so well incased. In fact, the employé confined in a car, particularly when closed, with any dead body is ever in danger; and I have no doubt but that many a life has been cut short from this cause.

Would it not be better, at a very little additional expense on the part of the railway companies, to cut off a small portion of their baggage cars for the transportation of bodies? This done, no employé's life can be endangered; no broken open box or trunk can become infected; no odor through the car—it matters not what the cause of death, or how poorly the body was prepared for shipping.

The following plan seems to me to be both feasible and practical: The length of an ordinary baggage car is from fifty to sixty feet, the width on an average is about nine and one half feet, the space required for the largest coffin and box (outside packing) would be twenty-eight inches in width, and six feet, eleven inches in length. This much of a cut-off at the end is all that is required. The box can go into said zinc-lined compartment, through an outside door made very much after the fashion of a large ice chest. This metal-lined compartment extending from the floor to the top of the car would easily accommodate half a dozen bodies.

It seems to me that the American Public Health Association is the organization that should call the attention of the different legislative bodies of the land to a subject of such vital importance.

DISCUSSION.

Dr. Peter H. Bryce.—The paper to which we have just listened has dealt with a subject of great interest to every provincial or state health officer. With regard to the necessity for great care to be taken in the

transportation of dead bodies, I do not see how it can be done unless we have previously provided for making the coffin and taking care of the corpse, and arranged with the people who are going to take the corpse from the cars.

Dr. J. D. Griffith.—It is necessary to have the casket hermetically sealed in order to prevent the escape of odor. We all know that a corpse is frequently put in a baggage car with perhaps twenty or thirty trunks, and if the person has died from an infectious disease some one is very apt to be infected later on.

Dr. P. H. Bryce.—Suppose you put the corpse in a casket of the kind you mention, you do not allow anything to come out. Is it purely to do away with the sentimental objection of those in the car?

Dr. J. D. Griffith.—We do away with a positive danger. The great source of danger is from infection that occurs through the exposure of trunks, and we rarely go into a baggage car in which we do not find some of the baggage or trunks broken down, which will readily absorb poisonous material.

A Member.—Do you think tuberculosis would be infectious after death?

Dr. J. D. Griffith.—That is a question. We know it is not hereditary.

Dr. P. H. Bryce.—Take a car with living consumptives in it, they are more dangerous than dead ones.

Dr. J. H. Gardiner.—I think the association should pass some resolutions or ask the different Trunk Line companies to carry out some suggestions such as the doctor has embodied in his paper. If the Association passes a resolution to that effect, I am certain that the Grand Trunk would be glad to protect their own employés, also the baggage of the people, from infection. It seems to me, it would be a small expense to have such a compartment as the doctor mentions in baggage cars. If the matter is properly brought before the railroad companies, I think they will do something. I have offered one resolution and I do not want to introduce another.

Dr. P. H. Bryce.—In order to properly dispose of this matter, I move that a committee be appointed to bring in a report at some future meeting of the Association on the whole question of the transportation of the dead. (Motion carried.)

A Member.—Would it not be consistent, inasmuch as we know that a living consumptive is very liable to spread contagion, for us to strive to restrict the transportation of the living body?

Dr. P. H. Bryce.—That is not the question under discussion. It is the dead we are dealing with.

Dr. M. Inglis, of Winnipeg, Manitoba.—In giving instructions for the transportation of the dead, the undertaker should see that the coffin is hermetically sealed, and if it is, I do not see how infection can take place, or how very much odor can escape.

Dr. W. H. Hingston, of Montreal.—When a body is taken from this

city, the physician is required to state that the person did not die from an infectious disease. I should be sorry to hear anything about the transportation of the bodies of persons who have died from an infectious disease, or at least the means of transporting them facilitated. On the contrary, we should put our foot down and, if possible, prevent the transportation of bodies from one place to another. They are a source of danger when they start and when they arrive, notwithstanding all the precautions that may be taken. I do not think I have ever permitted the body of a person who had died of an infectious disease to be transported and interred elsewhere. The railway companies are not compelled to carry the bodies of persons who have died from infectious diseases under any circumstances. As I say, I should be sorry if this association with all its wisdom, should pass a resolution making it easier for the railway companies to set aside a compartment in baggage cars for the transportation of the dead as a means of security during their passage. This compartment will not prevent danger in starting, and more especially on arrival. That is the view I take of it.

Dr. C. A. Hodgetts, of Toronto.—I am a young member of the Association, but I desire to say that it is a mistake to allow the transportation of the bodies of those who have died from infectious diseases. If it is decided that the bodies are to be cremated, then the parties interested may be allowed to move the ashes. I think it would be a step backward to allow the transportation of the body of a person who has died from an infectious disease. The bodies should be buried within twenty-four hours in the place where death occurred. We should not pander to the morbid sentiment of the public in regard to this matter, but we should take a decided stand to protect the living, and the only way to do that is to bury the bodies in the place where death occurred.

Dr. J. B. Lindsley, of Nashville, Tenn.—I agree with Dr. Hingston, and I think our state boards should take some action with reference to the transportation of bodies of persons who have died from infectious diseases. I hope that the committee that is to be appointed will bring in a report of this whole question of the transportation of the dead. It is the law of humanity that where a person dies from an infectious disease whether on land or at sea, there shall he or she be buried.

Dr. J. D. Griffith.—I agree with Drs. Hingston and Bryce that, from a sanitary standpoint, no dead body should be shipped. That is the proper way to put it, not that this or the other dead body which we supposed has died of a non-infectious disease. We do not know which disease is infectious and which is not. We have only partially decided that point in pathology. The ashes may be transported after the body has been cremated. There is no objection to that, but I regret to say that we have not educated the public up to that point as yet.

Dr. J. B. Lindsley.—The public are better educated than we are.

Dr. J. D. Griffith.—Yes, but we do not see it. In order to bring this matter more pointedly before you, I will say this: Let us suppose,

for example, that it is my child or wife that dies in California of diphtheria, measles, or small-pox. That is the way to put it. The child or wife, as the case may be, is as dear to each one of us as possibly can be. Suppose your burying ground is at Kansas City, what are you going to do? I have appealed to the health officer of California and he has told me that I cannot ship the body. He says, "I cannot let that body go." I say, "Well, doctor, how do you know that the child died of diphtheria!" "The physician said it did." You say to him, "I am going to take the body of my child home, it makes no difference what it costs. I will pay five thousand dollars, if necessary, to do it." That puts the health officer in a bad position. I have seen such a case within the last year. The undertaker has done his best, and every precaution has been taken, still you are not allowed to move the body.

The plan I have proposed is a feasible one. I have brought it before you in order that we may adopt some means of guarding against the infection of both the employés of railways and the baggage of people which are constantly exposed.

THE RESTRICTION AND PREVENTION OF TUBERCULOSIS.[1]

By N. E. WORDIN, A. M., M. D., Bridgeport, Conn.

When, in 1865, Villemin injected guinea pigs with sputum from consumptives and found the same disease produced in those animals, he started a thought in the minds of men which, like the germ within the body, has grown, until now phthisis is established as an infectious disease. When his servant, incredulous, as many are now, boldly entered the room filled with tuberculous spray and took the disease which ended in his death, he furnished a practical proof of the fact we are emphasizing to-day, that the germs of tuberculosis, inhaled by a person, may cause the terrible disease.

I make the statement without fear of successful controversy, established as it is by the research of scientists and the observation of clinicians phthisis pulmonalis is not, necessarily, an inherited disease. Given, a tendency, which may come by inheritance, and the admission of the germ, and the disease will follow. Given, the tendency and prevent the admission of the bacillus tuberculosis, and the person will escape.

This is a fundamental advance which signalizes the decade just past:—the lifting of the whole class of fateful germ diseases out of the region of the intangible and mysterious, and their establishment, on the basis of positive experimental research, into the domain of the comprehensive and the definite. The things which cause them are no longer to us mysterious emanations from the sick, or incorporate expressions of malign forces against which conjurations or prayers could alone promise protection, but they are particulate beings, never self-engendered, never evolved in the body, always entering from without,—"things which we can see and handle and kill."

"For over two thousand years," says Dr. Rohé, in his president's address before the Medical and Chirurgical Faculty of the State of Maryland, "a portion of the medical profession has believed in the contagiousness of consumption. Observation alone, aside from scientific research, strengthens the long existing belief. Its appearance in families where it cannot be hereditary, its frequent occurrence in nurses and those who have personally attended upon its victims; its onset in those who have occupied rooms previously vacated by consumptives; its striking down the devoted wife, the faithful husband although strong, robust, and untainted; such facts as these, observed over and over again, in various countries, are strong circumstantial evidence of the communicability of this disease." Added to these is such testimony as Dr. Flick gives. After laborious and careful study of the causes of death in the fifth ward

[1] Read at the Montreal meeting of the Association.

of the city of Philadelphia for the years 1863–'87, he found that all the deaths from tuberculosis occurred in less than one third of the houses, while in 1888 over one half of the deaths from the same cause occurred in these same houses. Inoculation experiments, feeding experiments, injection experiments, all result in death from tuberculosis. Cornet injected dust gathered from private rooms, wards in hospitals, asylums, and prisons where consumptives had lived, and in about one in six animals produced characteristic tubercular nodules containing tubercular bacilli.

The results obtained by Villemin were soon confirmed by Chauveau and others, and since the discovery of the tubercle bacillus by Koch in 1882, the view that tuberculosis is an infectious, let us rather say, a communicable disease, has gradually pervaded the profession until to-day I make the statement that it is so, without fear of controversy.

My first statement is, then, that consumption is an infectious, communicable disease. My second, that the source of the infection, the cause of the disease, is a germ. This germ alone can cause consumption. Without the passage of this specific germ into the body, without the transmission of this particular germ in some way or another in a living condition from the sick to the well, consumption cannot develop, cannot spread. Consumption may be prevented then, by preventing the germ from entering the body. How can this be done?

A knowledge of the germ and its nature will help us to answer. It differs from all other germs, in that its growth is very slow, requiring weeks and months for full development. This slow growth of the germ gives opportunity for combating the disease with treatment. The germ requires a special temperature, namely, 99–102° F. It cannot grow without this heat. Nor can it grow without moisture. Heat will destroy it. We may disinfect, then, by steam or fire.

But while this germ cannot grow without moisture, it will live when dry. While heat and sunlight will kill it, it can remain alive in the dry state for many weeks, just how long is perhaps not definitely known. It would seem then that we must destroy the germ before it has become dry; i. e., as soon as it escapes from the body.

This brings me to my third statement, that the germ, the source of infection, passes out from man by the sputum and that that is the principal source of danger.

The myriads of tubercular germs which are found floating in the air, like motes in the sunbeams, do not come from the feces. The habits of only the most filthy would permit that. Excrement is quickly removed and the mode of disposal of the discharges protects us from danger from that source. Besides, it is impossible for any organism to leave a moist surface and to be carried off by a current of air. For the same reason, the breath of consumptives contains no bacilli and is not infective. Even when the lungs are full of broken down tissue swarming with bacilli, the latter are only in the rarest instances, if at all, exhaled in the breath.

Direct examination of the expired air of consumptives confirms the absence of the tubercle bacillus.

We exclude then the feces, the urine, and the breath. We know that the sputum is full of the germs. Almost every one present here has seen this. We find them under the microscope and consider this as a sure means of diagnosis.

The sputum, then, is the principal means, by which the germ, the source and cause of infection, the *fons et origo mali*, leaves the body of the sick person. If we are to prevent the spread of this infectious disease, we must attack the sputum.

As we have already seen, there is little danger from this so long as it is moist. But there are some ways in which it may be directly transmitted, as by kissing. Among the hygienic commandments there should be one for the diphtheritic, the syphilitic, and the consumptive,—thou shalt not kiss. Direct inoculation may occur through coughing, by soiled hands and clothing. But the cases thus transmitted must be very few. The only danger worth considering is from the sputum after it has become dried. The solution, then, of the whole question resolves itself into this, that in order to prevent the spread of this terrible disease, it is only necessary to destroy the sputum as soon as it is emitted from the person, as soon as it has become dried. How can this be done?

Fire is the best purifier. A temperature of more than 99° C. will destroy the bacillus. The heat of an ordinary oven or a steam sterilizer may be used. The destruction of the germ is an easy matter. The difficult thing is to get it—to retain it before it has escaped into the air and become dried, has become one of the minute particles which lie hidden on the carpets in the corners of our rooms, on the curtains, the wall-paper, in the waiting-rooms of our railroad stations, in our public conveyances, in the soft upholstery of our palace cars and in the bedding of the sleepers,—in every resting place whether of the rich or poor, whether of pleasure or of penance, public or private. The costliest vase may hold the deadliest germ; the loveliest work of art, the seed of death.

In order that preventive work may prevent, it must have the coöperation of those for whom the labor is bestowed. Medicine is no longer the mystery which once led the sick to the temple of Esculapius to be cured by ablution, prayer, sacrifice, and sleeping at the feet of the god during the performance of the sacred rites. Though Hippocrates was for a long time the Father of Medicine, not his great name can bear up either the humoral theory or the empiric system, and our noble profession has been equally freed from the mysticism of a priesthood. *Addictus jurare in verbis nullius magistri*, may well be the motto of every intelligent physician. With the increased intelligence of the public has come an increased knowledge of all kinds—and of medicine as well. With the teaching of physiology and hygiene in our public schools, with the regulation required by law for quarantine, isolation, and disinfection from infectious disease, has followed almost necessarily some knowledge of the nature of those dis-

eases. The layman knows about the germ as a disease-producer and many times he is a willing coadjutant in sanitary work. The education of the laity, therefore, upon the infectious nature of tuberculosis and the importance of the individual measures of prophylaxis must precede any successful enforcement of legal enactment, looking toward the restriction of the disease.

"A disease which in mild or severe form affects at least one half of the whole human race, and which causes the death of full one seventh of all who pass away, killing about one third of those who perish between the ages of fifteen and forty-five,—a disease which is most insidious in its onset, and often relentless in its course and which may largely be prevented—is one about which we cannot be indifferent," is the one about which the public should be taught. This may be done in different ways, but I believe the most practical and the quickest would be to put tuberculosis on the list of infectious and communicable diseases to be reported to the health officer. Following this there should be a thorough disinfection of all houses in which tuberculosis has occurred, and the recording of such action in an open record.

In the second place, there should be compulsory disinfection of hotel rooms, sleeping-car berths, steamer cabins, and prison cells which have been occupied by consumptives, before any other persons are allowed to occupy them. Our southern railroad and steamship lines are constantly carrying invalids in ghastly crowds which can be tracked, almost, by their sputa. These poor sufferers, seeking a fountain of health, unwittingly leave behind them in their train death-dealing dangers more dreadful because unseen, uncared for. The transportation companies which fatten on this traffic and which, by implication at least, offer safe traffic, should be compelled to thoroughly disinfect cars and bedding, under the superintendence of the board of health of each state as they come within its borders.

In the third place, there should be special hospitals for the treatment and prevention of tuberculosis. Whether these be established by state, city, or private philanthropy, the more of them, the more surely will the disease be kept within bounds. A large portion of the sick with this disease can be taken care of intelligently and well in their own families. The rich, the well-to-do, can frequently prevent the spread of the disease from and into their own spacious and well-supplied homes. But the crowded poor who barely eke out an existence, and so long as they do live, under the conditions are a constant and positive source of danger to the community. One of the resolutions adopted by this Association at its annual meeting at Chicago, last year, is—"A person suffering from tuberculosis can be made entirely harmless to those about him by thorough sterilization of all broken down tissue immediately upon its being given off. With proper precautions it is therefore possible to live in the closest relation and upon the most intimate terms with consumptives without contracting the disease. Isolation will not be necessary for those who know

how and are able to do this. The isolation hospital will be for those who do not and who can not, and may be used only until it has taught the ignorant and their friends."

In this connection I must be allowed to quote from Dr. H. B. Baker who, in a paper on "The Relation of the State to Tuberculosis," read before the Michigan State Medical Society, said (p. 115, Transactions, 1894), "I dwell upon the utility of a state hospital for consumptives, not for its benefits to a class of unfortunate citizens worthy of sympathy and of all possible aid to recovery, but especially as a means toward the restriction of tuberculosis. In that restriction the state has an immense interest. Three thousand new cases each year, three thousand deaths, and six thousand persons constantly sick with consumption, in Michigan, implies, I think, a loss of more than three millions of dollars per year and an amount of human suffering which, when we think of it as unnecessary, is simply appalling."

Other states are not able, as is Michigan, to report the number of cases of consumption within their borders, but the statistics of states show the proportion of deaths of consumption to all deaths is about 11 per cent. In the report of the tenth census of the United States, the last one published, the following facts are found: Consumption heads the list with the greatest number of deaths, having 91,270 annually; 12,059 in every 100,000 of population. The great majority of deaths from it occur between the ages of fifteen and sixty-five. The greatest number in any decennium is from twenty to thirty and that the proportion is greatest in the large cities.

It would scarcely be becoming in me to enter here into the details of disinfection, isolation, and the regulations which may be necessary or advisable. It goes without saying in this assembly that no tuberculous female should nurse a child, that milk from a tuberculous animal should never be used, that overcrowding in houses should be prevented, that plenty of fresh air and God's sunlight should be provided, that the consumptive should never spit upon the floor of public or private building or conveyance, that the sputum should be immediately burned, whether it be injected into cloth, paper, or prepared spittoon, that the bed and body clothing should be disinfected by steam or washed and boiled by itself, that no one should sleep in the same room with a consumptive or in the same room which has been occupied by one sick with that disease, until after such room has been disinfected, that milk should be sterilized before being fed to children, that there should be public inspection of dairies and slaughter houses and tests of cattle with tuberculin so that tuberculosis may be exterminated from cattle, that dust scattering should be avoided by the banishment of the dry broom and the feather duster and the use of moist cloths and chamois, and that general hospitals should provide special wards for patients with this disease, and enforce in them the proper measures for the limitation of infection. It is ours to lay

down principles, to put the standard in the van, to educate, to influence public opinion.

Cui bono—what is the use, does some one say? Michigan has taken the advance in requirements of notification and restriction of this disease. She has already reaped an abundant reward. In 1878, the cases of consumption were .71 and this proportion has steadily decreased every year, until in 1889 it was .49. The secretary of the New Hampshire state board of health in his last report, 1893, says: "There was considerable diminution in the mortality from this disease between the years 1884 and 1889. We have entertained the belief that an increased knowledge of the nature of consumption and the measures necessary to restrict and prevent it may have had some influence in causing this reduction."

Again, in Massachusetts, whose state board is the oldest and one from which we learn so many valuable things, reports that in 1892, the ratio of reported deaths from consumption to the mortality reported from all causes was 111.33 per one thousand, while that of previous years was, 1886, 156.3; 1887, 141.1; 1888, 134.2; 1889, 125; 1890, 130; 1891. 116.5; 1892, 111.3.

Dr. Flick also, who has come to be an authority before this Association on this subject, in an article in the *Philadelphia Medical News* for May, 1893, has given a table of the general mortality from consumption in the city of Philadelphia for the years 1861–'91 inclusive, and says, "If we study the mortality rates from pulmonary tuberculosis side by side with the number of deaths from the disease and the population for the thirty years as a whole, we shall see no diminution until since the doctrine of contagion has been more generally accepted and that the decrease from 1881 to 1891 amounted to a saving of seven hundred and eighty-four lives per year. But statistics are tiresome; some even say they can be made to prove anything. Let us turn to history for a change. On page sixty of Vol. XVI, Papers and Reports of the American Public Health Association, is a paper on "The Prevention of Tuberculosis," by Dr. Flick. It tells us that the first example of an attempt at a thorough restriction of tuberculosis was a decree of the sovereign of the kingdom of Naples, in 1782. This decree contained seven propositions, in substance as follows:—

1. When the physician had established that there was ulceration of the lungs, he was to report the patient, under penalty of three hundred ducats for the first offence, banishment for ten years for the second offence.

2. The authorities were to make an inventory of the clothing found in the patient's room, which was to be identified after his death. If any opposition was made, the person offering it was to have three years in the galleys or in prison, if he belonged to the lower class; three years in the castle and three hundred ducats, if he belonged to the nobility.

3. Household goods which are not susceptible to contagion were to be immediately cleansed. Those susceptible were to be at once burned and destroyed.

4. The authorities themselves were to tear out and replaster the house, alter it from cellar to garret, carry away and burn the doors and wooden windows and put in new ones.

5. The sick poor were to be at once removed to a hospital.

6. Newly built houses could not be inhabited for one year from their completion, and six months after plastering had been finished and repairing been done.

7. Superintendents of hospitals must keep in separate places clothing and bedding for the use of consumptives.

Other severe penalties are threatened to those who buy or sell objects which have been used by consumptives, to servants, members of the family, and to any transgressor whomsoever. We could ask no more than this. We would never obtain as much, unless in a stricter government than we are ever likely to see on this side the Atlantic. The result was wonderful. It is estimated that in 1782 the mortality from tuberculosis in the kingdom of Naples was ten per one thousand of population. In 1887, the official statistics for the Neapolitan kingdom showed that the death rate from all forms of tuberculosis was only 2.05 per thousand.

An ounce of prevention is worth tons of cure here. I plead before you, gentlemen skilled in sanitation, learned in law, influential in high places, I plead for such restriction as shall lead to prevention of this, the great white plague, which claims its victims from those in the flush and bloom of youth, in the prime of life, from the ranks of the fairest and best in the land; the student fully equipped, ready and eager for work, determined to reach the high goal which his high ambitions have set; the young and beautiful girl with all possibilities before her, cut down like a flower of the field.

TUBERCULOSIS: ITS RESTRICTION AND PREVENTION.[1]

By JOHN M. O'DONNELL, M. D., Winnipeg, Manitoba.

Tuberculosis is an infectious malady, caused by a micro-organism, to which has been given the name of bacillus tuberculosis. The bacillus once planted in the tissues may give rise to a mere local lesion, as for instance, when it is inoculated into the skin; or may affect one particular organ, such as the lung, far more than any other part; or may be generally diffused.

Tubercle is essentially a disease of surfaces and channels, and this is so far true, that bacilli can reach the tissues only by such surfaces and channels, and in these channels there are irritant secretions, often containing numerous micro-organisms and other products which assist in completing and hastening the breaking down process, commenced and partially continued by the tubercle bacilli.

STATISTICS OF TUBERCULAR MORTALITY.

Hitherto we have had no trustworthy guide as to the number of cases of tuberculosis, save that of the death returns. In the Registrar General's returns, England, tuberculosis is divided in phthisis, tabes mesenterica, tubercular meningitis, and other forms of tubercular disease and scrofula; some of the latter are probably not correctly diagnosed, and that the mortality is rather likely to be under than be overstated.

Females are more liable to tubercle than men, in the proportion of 0.2 per 1,000 of the population. It may be stated generally, that the mortality is greatest at birth, diminishes rapidly till the fifth year, more gradually till about the fifteenth, and then begins to rise, at first slowly, then rapidly to the end. In the early years, taken as a whole, the mortality is low; but from fifteen to twenty-five it is high, after this age the mortality somewhat declines. It must, however, be remembered, that during the first five years of life, errors in diagnosis are most common, and it is probable, that many children die of tubercular meningitis, and from tabes, the deaths being returned as from convulsions, teething, diarrhœa, and so forth. In the brain or its membranes, the embolic tuberculosis must be looked upon as part of a general process. Tubercular meningitis oftener occurs between the third and eighth years, than at any other time. Intestinal is most common the years following childhood, from twelve upwards, for six or seven years.

Although the intestines are directly affected by tubercle in such a small proportion of cases, the mesenteric glands are found to be, in some

[1]Presented at the Montreal meeting of the Association.

stage or other of tubercular degeneration, in nearly 79 per cent. of the whole.

In many instances the primary foci will be found in the lymphatic glands of the mediastinum, alone, or with those of the mesentery; the age at which these tubercular glands appear in the mesentery is significant.

Out of 100 cases reported, there were 4 in which they appeared in the first year of life, 33 in the second, 29 between 6 and 7, 13 between 8 and 10, and 9 between 11 and 15.

Here again the figures are higher during the earlier periods than during the latter years, but the maximum is reached, as with ulceration of the intestines, at a distinctly earlier period than in the case of meningitis. In 14 cases, the glands only were found affected, i. e., there was no tubercle found in any other part of the body. In cases where the glands only were accompanied by ulceration of the intestines, there was no peritonitis, and accordingly secondary tubercle could be found in no other part of the body, so that the tuberculosis of the mesentery glands must be looked upon as the primary lesion.

Continuing the analysis, it was found that in 100 cases the glands at the root of the lung were simultaneously affected in 69 cases, and in 62, the lungs were also affected; in 13 there was tubercular peritonitis, and in 18, ulceration of the intestine was found.

Of the remaining cases, four had tubercular peritonitis, and four, ulceration of the intestine; in 12 cases the mesenteric and mediastinum glands, the peritoneum intestine, and the lungs were all affected; whilst in no fewer than 53 of the 100 cases there was evidence of localized peritonitis—recent or old, occurring between the spleen, or liver, and the diaphragm.

Dr. Goodhart, speaking of this condition, says, "Caseous or tubercular disease of the mesenteric glands is not uncommon; nevertheless, it is a rare comparison with the consumption of the bowels, which is so often heard of in the dwellings of the poor."

Professor Gardner, in his lectures to practitioners, draws attention to the fact that as pathological descriptions can deal with fatal cases only, a far too grave prognosis is arrived at in cases of tabes; and that consequently many cases of tubercular diseases, not only of the mesenteric glands, but also of the peritoneum, recover; only the more grave cases succumbing. It is evident from all this that tubercular conditions of the abdomen are more common than can be inferred, even from the figures above quoted, where only one fifth of the real number are stated in the diagnosis charts, to be suffering from abdominal tubercle.

That there is a great tendency toward calcification and cicatrization, especially where the lesions have a high resistant power, is well known to all pathologists, who constantly find cicatrices, which are to be recognized as of tubercular origin, by the presence of small caseous or calcareous nodules, in which, however, the tubercle has become quiescent, these are

the result of local tubercular changes, the localization being due to the activity of the tissues.

The late Dr Farr, from his life table, calculated that 114,417 out of 1,000,000 children born, die of phthisis; at some period of their lives these might therefore be considered predisposed, or, in other words, they had less resistent power than other people; he then constructed a hypothetical life table, of the dying, or to die, of consumption, by picking out the survivors of the 114,417 at any age, and putting them into a class apart: such a table illustrates well the effect of age.

Number to die of consumption at and after each age, out of 1,000,000 children born:

Under one year, 114,417; age 5, 109,948; age 10, 107,809; age 15, 104,283; age 20, 95,209; age 25, 81,424; age 35, 55,920; age 45, 31,886; age 55, 15,418; age 65, 4,973; age 75, 679; age 85, 52.

Outdoor occupations are less liable to tubercular maladies than indoor; a rural population is therefore less liable than an urban population; those who are well housed, and have ample cubic space, are less liable than those living in the reverse condition. The spread of tuberculosis in this respect, strictly follows the law governing the spread of zymotic diseases generally. The one-roomed population of towns have a much higher mortality than those who can afford more than one room.

Two causes tend to produce this result; the one, is the low state of health breathing an impure atmosphere produces, and hence a less resisting power; and the other is, that the nearer the infected and healthy are, the more prone is infection to be conveyed.

Dusty trades, or occupations, are liable to produce tubercular lung disease.

C. Lombard *(Recherches Anatomie sur l' Emphipene Pulmonare)* found the order of fatality to be (1) mineral dust, (2) animal, (3) vegetable. In 1,000 deaths from consumption of adults, he found they could be classed according to their occupations, as follows:

Occupations:— With mineral and vegetable emanations, 176; with various dusts, 145; sedentary lives, 140; workshops, 138; hot and dry air, 127; stooping position, 122; sudden movements of arms, 116; muscular exercise and active life, 89; exercise of the voice, 75; living in open air, 73; animal emanations, 60; in which watery vapors were breathed, 53. The result is conformable to the micro-parasitic theory of tuberculosis.

The researches of Greenland Tusker and others have clearly proved that the number of bacteria in the atmosphere of a room, or place, is dependent upon the greater or less amount of dust in a quiet room, such, for example, as a hospital ward, early in the morning, before any sweeping, dusting, or bed-making has been done; the bacteria are very small in numbers, because they have settled down with the dust on the floor, the walls, and other objects; the bacteria attain their maximum numbers when there is the maximum amount of dust in the air. It is therefore no

wonder that a disease like tuberculosis should be so widespread, and against which no precautions are taken, it infects the dust of workshops and living rooms, and the bacilli dust-born are breathed. Now is it a matter of surprise that metalic dust, that is, dust having sharp angles and spicular, should be more likely to wound the mucous epithelium, and open a door, as it were, for the bacilli to enter, while the softer vegetable fibres have not so great an effect?

The researches of Drs. Bowditch and Buchanan, working independently, successfully established the fact, that there is a relation between dampness of soil and tubercular affections. Dr. John Simon, and others, have shown that draining of soils diminishes the death rate from consumption.

Dr. Andrews, of the Chicago Medical College, has studied this geographical distribution of consumption in the states, and has shown that it is most abundant near the sea, and diminishes as we recede from it; at equal distances from the sea it prevails at the north and diminishes toward the south; for example, beginning at Massachusetts and going westward, the proportion of deaths from all causes, regularly diminishes as we recede from the Atlantic.

The deaths from Massachusstts, 25 per cent.; New York, 20 per cent.; Ohio, 16 per cent.; Indiana, 14 per cent.; Illinois, 11 per cent.; Missouri, 9 per cent; Kansas, 8 per cent.; Colorado, 8 per cent.; Utah, 6 per cent.; and then in California it increases to 14 per cent., on account, according to Andrews, of the proximity of the Pacific ocean; a similar decrease is observed in going from north to south, viz., Michigan, 16 per cent.; Indiana, 14 per cent.; Tennessee, 12 per cent.; Alabama, 6 per cent.

Hence, tubercular diseases seem to follow closely the moisture and temperature of localities; Massachusetts is ten times as fatal to consumptives as Georgia, and Minnesota, near the lakes, is twice as fatal as Georgia. The combination of damp soil and atmosphere laden with moisture, and variable weather, are favorable and the reverse for the dissemination of the malady.

Influence of season on tubercular fatality, this has been worked out; Buchan and Mitchell's research, (a journal of the Scottish Meteorological Society, 1874–1875). It would of course be more interesting to know at what season of the year the tubercular process commenced, than when it terminated; but this is not possible until tuberculosis in all its forms is notified under a list similiar to the infectious diseases notification list.

Buchan and Mitchell have shown that the mortality from tabes follows very closely the temperature, the maximum being from the middle of July to the middle of September, similiar to the maximum of diarrhœa mortality; and in point of fact, the deaths from tabes are mostly hastened by diarrhœa; the absolute minimum is from the end of December to the beginning of February. The relation of phthisis to weather they have delineated in a curve, and remark; the absolute minimum occurs in the

last week of September, after which it begins steadily to rise to the middle of November; it rises still more quickly during the last three weeks of December; it falls a little, rises again in the beginning of the year, and remains steady until the second week of March, when it rises to the annual maximum, during March, April, and May; from the middle of July to the middle of November, it is below the average; this is one of the most noticeable in its main features from year to year.

THE PREVENTION OF TUBERCULOSIS.

The medical officer of health at present is neither aided by public opinion, nor by statute, in any attempt he may make to directly stop the propagation of tuberculosis; the only way open to him is to direct his attention to dampness of habitation, to overcrowding, to tuberculous meat, and to diseased milk; in all these points he has a certain amount of power, but to isolate the infected person, to disinfect articles infected with tubercle bacilli, he has no power unless he can get the authority to consider it as an infectious disease; this may possibly come in time, but the knowledge that the medical and the scientific world possess is distinctly in advance of the knowledge of the people at present; the people will have to be educated on this matter, and when the danger of catching consumption is fully recognized, there will be no difficulty; in the first place of obtaining power to isolate those cases, where it is likely to be dangerous to the healthy; and in the second place, to have the sanitary authorities notified of each case.

From the large number of victims of tuberculosis in this country, it is a far more important malady to have notified, than such an infantile complaint as measles.

Phthisis and miliary tubercle, in a public sense, seem exactly as an infectious fever; the sufferer should be isolated, the liquid and solid excretion disinfected perfectly with a 10 per cent. carbolic acid, and the sputum of the phthisical received on rags or paper and burned.

The propagation of tubercle by milk, is to be met by a more rigid inspection of milch cows than has heretofore been made; and when proper abattoirs are established throughout the country, a strict meat inspection will then be possible; but until that is done, a very large amount of the meat consumed must be derived from tuberculous animals.

THE BEST LOCATION TO RESTRICT AND PREVENT THE DISEASE.

Between the forty-fifth and fifty-second parallell of latitude; from the fact that by far the greater number of persons affected or predisposed to tuberculosis, die during their youth, and the difficulties presenting themselves in the way of isolation or bringing such cases under the local health acts, make it apparent that some other means must be adopted for its restriction and prevention. People will strenuously object as much to being pointed at as a consumptive, by the authorities, as to being called a leper, and the opposition to such legislation will be found to be vigor-

ous. Up to the present the health authorities all over the world have dealt only with acute infections, except in the case of leprosy. Tuberculosis would naturally be classed as practically the same thing, and the people would oppose it to the full extent of their power.

It is also to be remembered that local health officers are often, I may say in the majority of cases, men of little experience. Placing a person under the ban of such a law by an incorrect diagnosis, would be lamentaable indeed.

Accustomed to think that warmth is essential to the treatment of pulmonary disease, it requires no little courage to face the severity of winter north of the forty-seventh parallel, where the snow lies nearly half the year and where the thermometer falls frequently to 20°, 30°, and even 40° below zero; nor is it easy by any stretch of imagination, to realize the fact that, in spite of this intense cold, the most sensitive invalids can drive in open sleighs with impunity, expose themselves without risk to falling snow, through hours of exercise, and in mid-day sit in the sun at the window, with the world white-crowned about them, and a spiky row of icicles above their heads; north of the forty-fifth parallel of latitude, the great merit is, that the nights and days present a cloudless sky, clear frost, and at most times an absolutely unstirred atmosphere.

At the same time it would be incorrect to say that there is no wind; March there, as elsewhere, is apt to be disturbed and stormy; and during the summer months the prairie winds frequently blow strongly for several hours, which may, and often does, cause discomfort to invalids; colds, strange to say, are rarely caught at such times, and easily gotten rid of if the invalid perseveres in remaining in the open air as much as possible.

I have observed during the last twenty-five years, that very little phthisis exists in the north, except in the mixed races, and that those who have contracted the disease in foreign countries, made rapid and easy improvement, on residing in locations as far north as the fifty-second parallel of latitude.

After a minute examination I advise them to give up medicines (except a very mild sedative cough-mixture when the cough is such that sleep is disturbed) and sit warmly clothed in the sun as long as it is shining, to eat as much as possible of food that they are able to digest, and to take exercise with caution, until I have formed a definite opinion of their capacity and constitution; then little by little I allow them to walk, increasing daily, until the daily walks begin to occupy from four to five hours. The one thing relied upon is air; to inhale the maximum quantity of the pure dry air, and imbibe the maximum quantity of the bright sunlight, is the "*sine qua non*"; everything else, milk-drinking, douches, baths, friction, counter-irritant applications, and so forth, is subsidiary medicine; I use but very little, except in cases where observation shows that it is needed, i. e., in cases where you have reason to fear hemorrhage.

The worst symptoms of pulmonary tuberculosis, fever, restless nights, cough, blood-spitting, and expectoration, gradually subside by merely living and breathing; the appetite returns, and the power of taking exercise is wonderfully increased; colds are rarely caught in a keen, dry, northern climate, and that recurrent fever tends to disappear, it enables the patient to inhale a far greater amount of air than is possible under almost any other conditions, and renders the invalid much freer in the indulgence of his appetite; the digestion is improved and he need not be afraid of eating and drinking what he chooses, while the bracing dryness and the stimulus that only comes from rarefied cold air, make him very ready indeed to eat; the result is that he speedily increases in weight, and when he has the strength to take exercise his whole body loses the atony of wasting sickness. It is a question whether the result of which I speak, is obtained by checking and obliterating the germs of a disease that tends to reproduce itself in the affected organ; or by fortifying the constitution and rendering less liable to the attacks of cold; or by the diminished pressure of the atmosphere on debilitated organs or respiration, or by the perfect purity of the air that travels over boundless fields of snow in winter, and prairie in summer, untainted by exhalations, charged neither with dust nor gases, nor with Professor Koch's redoubtable bacteria; or else by the tension of the nervous system that reanimates and rallies the last sparks of life in the exhausted organism; but of this I am satisfied, that a large percentage of hopeless cases attain rapidly, and without relapse, in the north, to the condition of ordinary health.

SHOULD THE MARRIAGE OF CONSUMPTIVES BE DISCOURAGED? [1]

By PAUL PAQUIN, M. D.,
Member of the Missouri State Board of Health.

Among the topics selected for discussion before the American Public Health Association at this meeting, we find a very comprehensive one, headed "The Restriction and Prevention of Tuberculosis." For many years, this question has received a great deal of attention in every part of the civilized world; but the feature which, in my judgment, is the most important, has been very sadly neglected. I have reference to the relation of marriage to consumption. It seems that the scientific world has considered this ground too sacred for decisive invasion, and that the medical practitioner has shrunk from the duties which his knowledge commands. While earnestly laboring to educate the people concerning the grave dangers of tuberculous infection from all other sources, the most unavoidable danger in the marriage of consumptives has been timidly considered in professional quarters, but scarcely ever openly discussed as it should be. If one reflects a moment, one cannot escape the conclusion that, after all, one of the most positive sources of transmission and dissemination of tuberculosis is not to be found in public conditions as bad as some of these are, but in the domestic centres. Indeed, after considering every other means of transmission and development of the disease throughout the world, we will find that, perhaps, all of them put together do not equal in potency, in comprehensiveness, in gravity, the direct and indirect power and effect of consumptive marriages.

It was objected to me once, that though the limitation of consumption, so largely disseminated by marriage, might be treated by suggestions from science, direct interference with marital relations and the matrimonial laws of God and nature does not enter into the domain of conditions to be ruled by the laws of man. It is possible that certain ethical or religious views may inspire one with the idea that to control marriage to the extent of limiting the privileges of those intending it, in any of those essentials which have always been held sacred, would constitute an outrageous violation of personal, innate rights. Ages of precedents, ages of unhesitating sanction, have firmly rooted in human nature, the notion that no one may interfere in the affairs of the heart of men and women in their matrimonial engagements. Nevertheless, the idea that man is not justified in interposing scientific rules in a question so grave, so serious, so universally important, as the very foundation of social order, social health, and the moral basis of the world, is not tenable. Science is justi-

[1] Read at the Montreal meeting of the Association.

fiable in attempting to regulate the ground work of human constitutions so as to produce the best physical, mental, and moral health—and surely science can do much in this direction. There exists nowhere else than in scientific teachings, a force capable of influencing, in a satisfactory degree, the prevention of consumption, as it occurs through family ties. I believe that we are justified, therefore, as a sanitary body, in taking into consideration, in all seriousness, the question of marriage among consumptives.

In the study of this problem, we are confronted at the outset with very complicated and unruly conditions; that is, the psychic and moral forces of men and women with respect to marriage. We find in these forces, elements so strange and peculiar, so difficult of analysis and control, but they crowd out reason and logic. Who ever married in cold-blooded common sense? Not even the learned disciples of Æsculapius, who know everything (?) physiological and pathological, remain entirely sane after being gored by the dart of Cupid. As a consequence, marriage is, as a rule, universally entered into without proper reflection, irrespective of physical, mental, and moral defects.

On the other hand, we are confronted with a feeling among the medical profession, that the marriage of consumptives does not always, necessarily, mean the infection of both of the high contracting parties; that it rarely results in bearing seriously diseased children, and that subsequent infection of the offspring does not always occur. These unfortunate notions seem to be based, on one hand, on the skepticism of a few men of reputation who still preach against the doctrine of infection of tuberculosis; and on the other, on the theory that heredity has far less to do in this malady than was supposed. In the light before the world, the first point hardly needs discussion. It is positively established that tuberculosis is transmissible by means of its germs. As to heredity, it plays a direct influence sometimes, and an indirect one almost always, in consumptive families.

Admitting then—as we must, if we believe in scientific truths—that tuberculosis is transmissible between human beings; from animals to man, and *vice versa*, and that, occasionally at least, children of tuberculous parents are born scrofulous and very frequently weak, we shall consider how it may be possible to interfere against the dissemination of this deadly disease by means of marriage, and what arguments may sustain this position.

We will first bring forth the arguments, that is to say, the reasons which militate against these marriages:

First, the close union and close intimacy of married life brings the infectious principles the common property, so to speak, of man and wife. Both inhale them more or less constantly and their home becomes a more or less polluted foci for themselves and others. The sputum, loaded with the germs of consumption—a daily expectoration may contain more than 20,000,000 bacilli—becomes almost hopelessly infectious by con-

stant cohabitation and close communion. Therefore, the healthy person marrying a consumptive is very seriously exposed to eventually contract the disease, and then there are two parties suffering instead of one. Were the damage to be limited here, there might be a slight excuse for the premarital argument that the hearts of the couple alone should rule in such matters, because then the question seemed to be purely personal. They might be considered in the light of risking only their own comfort and their own lives—a risk which, however, is itself very wrong indeed. But the danger and injury only begins at the altar of matrimony. Aside from the fact that the marriage of a consumptive with a healthy person eventually increases each time the number of consumptives by one, it also increases the number of living, moving centres of infection by one, thereby augmenting the danger to the public at large in every instance. But this is not all. The worst fact is that such a marriage creates an infectious source of generation of new beings. Such couples must almost necessarily, at some time or other, bring forth more or less tainted constitutions, if they bring forth anything. It is true that occasionally from a consumptive couple, or a marriage in which one of the parties is consumptive, there may issue healthy children, so far at least as appearances may reveal, but even then they are from the outset comdemned to breathe and grow in a polluted atmosphere in which any organic weakness renders one susceptible to the infection.

Children born of consumptives, whether they have a weak constitution or not, are predisposed to the development of the disease, because of their constantly infectious surroundings; and those born feebly constituted are naturally fertile soil for the growth of germs of tuberculosis. One needs only to observe and reflect upon and study the families of consumptives, and consider their history from the time of the parents' marriage to the adult growth and marriage of their children, to realize that indeed the marriage of tuberculous people is often a deliberate creation of a pest-house, the result being more or less serious, according to circumstances. And if all this is true of a couple of which only one was diseased before marriage, it is still more serious when couples were both consumptives at the moment of marriage.

Another strong argument against the marriage of consumptives is found in the question of children's rights, which, with all our boasted refinement, with all the grand achievements of civilization, with all the protection and guidance of religions of all denominations, have been almost totally ignored and neglected, ever since the institution of marriage. The children's rights are not even thought of before marriage, in the great majority of cases. Prospective children are considered flippantly. Indeed, they are sometimes thought of as though they might be toys for the amusement of parents; or, which is worse, they are considered too frequently in the hope of preventing their birth. The many rights of children in all circumstances and conditions of life, demand recognition at the hand of science. Justice demands that they be considered and

weighed and enforced, even before birth. But no right of theirs is greater than that of being born healthy. Except by unavoidable accidents, no child should be born diseased, condemned in advance to suffer always and die young. Therefore, parents organically defective, should be very cautious, and I take the ground that no one with consumption should marry.

Who will contend that it is a right to bear children condemned before their birth to a life of misery, a life of suffering, and even a life of mental weakness? It seems to me a cruelty no less criminal, to do such a thing knowingly, than it is to tyrannize and kill after birth. And yet, every day the laws of the land and the laws of the church unite consumptive men and women, and thereby organize sources of disease and grief and, shall I say, institute legal conditions for crimes of cruelty. Is it not, therefore, the duty of sanitarians to point the evil effects of such marriages? Is it not, indeed, their duty to seek redress from this fatal source of infection of the world? When we consider that the vast majority (about one sixth) of all the deaths in civilization are due to consumption, when we consider the extraordinary number of the unfortunates born defective or predisposed to tuberculosis, or condemned to live in an infected atmosphere, it seems that there can be no question as to the justice and propriety of science to protest against the marriage of consumptives, and against the conditions likely to produce the birth of consumptive children.

Now, as to the means of preventing such marriages:

First, there should be established campaigns of education by public lectures.

Second, the practising physicians should strenuously discourage these marriages and educate their patrons to properly disinfect against tuberculosis.

Third, the public school children should be instructed on sanitary science, and particularly to avoid spitting on the floors, etc.

Fourth, every state should have sanitary regulations and a system of public instruction to disinfect houses and guard against the ravages of the disease. The boards of health should be provided with microscopists to diagnose the disease for the practitioners, and to promulgate proper sanitary instructions to the public.

THE CLIMATIC SEGREGATION OF CONSUMPTIVES.[1]

By HENRY SEWALL, Ph. D., M. D.,

Secretary of State Board of Health of Colorado.

From a philosophical standpoint, the greatest achievement of modern times is the bringing of vital phenomena within the scope of natural law. Modern research seeks to discover the cause of disease and the conditions under which this cause acts, and then, by a simple mathematical process of deduction, announces the remedy.

It is nothing new in history that the teachings of great truths need many expounders before they win disciples; and this essay pretends to announce no discovery, and advances no theory, but is a plea for action on lines which the pioneers of science have marked out with precision.

It will be my effort to outline a reasonable method for the frequent cure, the inevitable prevention, and, perhaps, the final suppression of consumption. It will, to-day, be considered no impertinence to assume that consumption is an infectious disease, due to the implantation and growth of a living organism within the afflicted body; and that, further, this organism exists in the sputa of pulmonary consumptives, which, becoming dry and pulverized, is inhaled by healthy lungs, and so elaborates the most common method of infection.

It is an observed fact that the prevalence of consumption increases with the density and overcrowding of population, and becomes endemically *nil* under known conditions of climate and habitation. It has, moreover, been called "the disease of civilized life" since it has not spontaneously invaded isolated savage tribes. In the ten or twelve years since the infectious nature of consumption has been recognized, the precautions that this theory naturally suggested have been followed by a perceptible decrease in the prevalence of the disease, in certain communities; and the fact that several of the more active state boards of health have authoritatively classed consumption in the list of preventable, communicable diseases, places a sufficient stamp of authority upon this view of its nature.

That a single one out of all known diseases should cause from one fourth to one eighth of all deaths in civilized communities, not to compute the disastrous effects of non-fatal cases; that this disease is demonstrably preventible, and even curable; it is no wonder that the splendid modern passion to relieve human suffering has concentrated itself upon the ways and means of overthrowing the reign of the great white plague, Consumption.

Small consideration makes it evident that no single means within our power is competent to overcome the enemy. The most certain and speedy blotting out of the disease would follow the instant and permanent isola-

[1] Read at the Montreal meeting of the Association.

tion in some far off region, of every individual afflicted with it; but mankind will choose to go on in suffering rather than shock his ethical nature in forcing such seclusion. Undoubtedly our main defence when the disease exists, depends upon the growth of broad and sound views of sanitary facts among the people; not merely the lip knowledge which repeats words, but the active realization of the burnt child that dreads fire. It is a pity that those modern educators who have induced state legislatures to dictate that the evils which may follow the use of tobacco and alcohol shall be described in the school physiology, should not have seen to it that the youthful mind might have demonstrated to it the nature and causes of infectious diseases, and the modes of combating them. An appropriate course of bacteriology would be a fascinating, comprehensible, and infinitely practical addition to the curriculum of the secondary schools.

But the diffusion of knowledge is slow, and of the morality which would make use of it is slower. Probably something could be gained in the repression of consumption by the notification to the local bureau of health of persons and places infected, as has proved so useful in the case of other infectious diseases. But the lack of unanimity among even those best qualified to advise concerning this, or any other practical mode of action, was recently well illustrated in the discussion on this subject, at a special meeting of the College of Physicians of Philadelphia, held January 10th, 1894.

The isolation in hospitals of consumptives in cities, especially the poorer and more ignorant classes, is a plan which has already worked great good; and of still greater advantage, undoubtedly, would be the segregation of the sick in country places, while still kept under the medical observation which would wisely direct the habits of life. In the experience of the past, it is not a bold assertion that consumption is incurable by any known drug, and that the single hope which the consumptive has is to improve the vital resistance of his own body. Moreover, it may be taken as established that the one essential factor, more important than all others combined, in this improvement of militant vitality, depends upon out-door life with its incidents of fresh, circulating air and sunshine.

Observation shows clearly enough that the place of residence of the consumptive is not indifferent; that, in general, it is better for him to change his abode from the place where the disease was contracted; that inland excel seashore resorts; that dry air is more beneficial than moist; that altitude above sea level is of decided advantage, and, above all, that purity of air, and absence of micro-organisms and the matters incident to their existence from it, are indispensable conditions for the improvement of the sick one. The literature of the climatic treatment of consumption is so widely read, and the knowledge of its facts so broadly known, that to reiterate evidence of its potence would be an impertinence.

I assume, without argument, that in the pure, dry, rare air, the variable temperature and sunshine of the arid region of the United States, particularly along the eastern slope of the Rocky Mountains, consumption in

a stage admitting of easy diagnosis can be, in most cases, so cured as to form no embarrassing factor in a temperate life; and, moreover, the disease in this climate takes root with such difficulty that its annihilation may be expected, if its existence depends on such cases. I am far from offering more than general explanations of the assumed fact. It is unfortunate that the zeal of most of those who herald the benefits of climatic change, has led them to expound the certain facts of clinical experience by theories welded in the heat of imagination, theories which, for the most part, are physically and physiologically demonstrably absurd.

Accurate observations on the physiological influences of high altitudes are almost wholly wanting. We do not know, for example, the influence of altitude upon arterial blood pressure. We have no data determining the nature and amount of the probable relative activities of excretion by the skin, lungs, and kidneys; while the effect of such change upon the nervous system is undoubtedly profound, its nature and extent as influencing sleep, and nervousness has, as far as I know, never been thoroughly detailed. Future investigation promises to throw much light on these questions. At present we cannot secure in the simple, but fundamental, conclusion from clinical experience, that certain important diseases, notably asthma, malaria, and consumption, are remarkably benefited and even cured, by residence along the eastern Rocky Mountain slope.

As to the class of subjects of pulmonary disease that do well in high altitudes, the oft repeated warning may be reiterated, that advanced cases have but little chance of arrest of the disease and still less of recovery from it; while the prognosis in most early cases is exceedingly hopeful. If people in the east would insist upon a thorough medical examination of the chest whenever there is a prolonged cough or loss of strength and weight, we would see fewer instances of the dread disease stealing its fatal march upon the human citadel until, when discovered, the surrender of life is speedy and certain. Consumption contracted in the east and without change of scene, habits, and occupation on the part of the patient is almost certain to have a fatal termination.

The elder Flint out of 670 recorded cases says "Seventy-five cases (a little over eleven per cent.) must be nearly all in which I have known an arrest of phthisis to take place, either with or without complete recovery, during a practice of thirty-eight years." The improvement in a considerable percentage of these accompanied change of climate. Contrary to popular belief, moderately high altitudes are rather favorable than otherwise to the recovery of cases with tendency to hemorrhage. The influence of nervous temperament as indicating fitness of patients for high altitudes does not seem to me at all clear, though my colleague, Dr. Carl Ruedi, concludes from his experience, mostly deduced in Davos, that phlegmatic dispositions and cases that require stimulation do well at high altitudes, while nervous, irritable persons who require sedatives, improve most at low levels. My personal experience has led me to regard the strength, steadiness, and compensatory power of the heart as by far the most impor-

tant factor for residence in high altitudes. If the heart can meet the demands upon it, which seem to me to increase in proportion to the elevation above the sea level, probably everything will go well; if, on the other hand, the heart fails to properly add to its power of beat, disaster will surely follow.

Let us now return to the two fundamental truths in which are focussed all our real knowledge of the means of subjugating consumption. First, the disease does not originate spontaneously, but is always directly or indirectly transmitted from the diseased to the healthy individual; therefore spread of the disease may be absolutely prevented by complete segregation of the afflicted. Second, experience shows that, when the disease is recognized early in its course, giving up on the part of the patient of confining habits and occupations, and entrance upon a consistent open air life, away from populous communities, preferably in climates where the air is dry, rarefied, and, above all, pure, and where the hours of sunshine are at a maximum, the disease may be, and usually is, cured, or at least so arrested as to form but a small factor in the affairs of the patient.

The so-called arid region of the United States forms—excluding Alaska—about one third of the area of the country. The term "arid" does not mean, as implied in the descriptive term of the old geographies, the "Great American Desert," the existence of a Sahara-like, sandy waste. The country is arid because the rain-fall, less than fourteen inches per annum, is insufficient in its distribution to support abundant crops. But that the soil is of boundless fertility is manifested so soon as the hand of man employs the natural reservoirs of water in artificial irrigation.

In this area, I would include as eminently suited to consumptives part of the states and territories of Wyoming, Idaho, Utah, Arizona, Nevada, New Mexico, and Colorado. Throughout this vast region localities may be found particularly adapted to special forms of pulmonary disease, but this essay will be limited to a few remarks on some familiar features of the state of Colorado. The area embraced in this region reaches from 37° to 41½° parallel of north latitude, and from 102° to 109° longitude west from Greenwich. It embraces about 500,000 square miles, and is larger than England, Scotland, and Wales, or nearly as large as New England added to New York. More than one third of the surface on the eastern part of the slope is formed of rolling prairie, the termination of that gradual ascent of over 900 miles from the Mississippi river. The ranges of the Rocky Mountains, forming the backbone of the continent, traverse the western half of the state, giving rise to numerous rivers, which, on the west, take their way to the Pacific ocean.

Running east from the main range at about the middle of the state, is a ridge of land known as the "Divide," the waters on the northern side of which take a northerly, and on the south side a southerly, direction. On the eastern slope of the mountains and touching, or within a few miles of, the foothills, are the towns and cities, Boulder, Greeley, Denver, Colorado Springs, Pueblo, and Trinidad. From the plain on the east to the

mountain peaks in the centre we may find every variety of altitude from 3,500 to over 14,000 feet. Along the foothills are numberless spots at an elevation of 5,000 to 6,000 feet, sheltered from wind, exposed to sun and within easy reach of the railway, where the air is so pure that the bodies of dead animals do not putrify but dry up without stench. Embraced within the mountains themselves are natural parks, verdure carpeted, abundantly watered, of a beauty beyond description; their elevation varies from 7,500 to 9,000 feet and their size from a few acres to the regal demesne of San Luis Park, containing 10,000 square miles. More than 270 native mineral springs having physical and therapeutic qualities which have given world wide fame to similar works of nature elsewhere, pour out in lavish waste unequalled volumes of water.

The whole population of this region is less than 500,000 souls. Nine main railway lines, with many branches and extensions including a trackage of over 4,600 miles, are found in the state.

The people, either as a physiological result of the climate or as a natural trait of the pioneer, are of peculiarly energetic temperament, and in no other state, probably, is there so large a proportion of college graduates and those who have enjoyed the advantages of higher education. Accordingly, in few communities do we find more active attention paid to the training of youth, particularly as to secondary schools. These are all matters of importance in the treatment of chronic invalids; for to tear such an one from the midst of loving friends and banish him to some desert region might, indeed, fulfil the physical conditions necessary to the restoration of health, but to most sick people such an existence would be a living death, and entered on with the greatest reluctance.

A most difficult problem to solve in every segregation of invalids is to provide mental occupation and amusement, and I hold that proximity to healthy communities, and keeping in touch with the affairs of normal life, are of special advantage to those who, like the majority of consumptives in the early stage of the disease, are not yet ill enough to realize their danger. Statistics are not available to do justice to the splendid record of Colorado as a sanatorium. To us who, as bread winners, have been obliged to live and work in its largest city, and even under these conditions have felt the joys of returning health and youth, while under much more favorable cônditions on the Atlantic coast the grasp of physical ruin had been all too palpable, there arises a feeling of wonder and gratitude for the deliverance; and we meet people with similar experience everywhere upon the streets of Colorado towns. When we look for the physical conditions that may explain such a result in Denver, a city of perhaps 150,000 inhabitants, we find that the hours of bright sunshine of 1892, e. g., formed 62 per cent. of the possible number of hours, while in Philadelphia, in the same year, they formed but 49 per cent., an annual death rate varying between eleven and fourteen per 1,000 including the large proportion of hopeless invalids brought here only to die.

We find the air in constant motion, which sometimes rises to the veloc-

ity of a strong wind, but never has a penetrating chill. The nights are never hot; perfect days prevail in March and November, and January seems a marriage of Winter and Summer. The relative humidity is but about 50 per cent. as against 70 per cent. to 75 per cent. in the principal eastern cities. A Denver physician, who is said to have made observations for twelve years, found but thirty-three sunless days in that time, and the average number of so-called cloudy days in Colorado for each year, is said to number about forty.

It is common to compare features of Colorado Springs with those of Davos-Platz, the famous resort of Switzerland. In Colorado Springs there average twenty-eight good days in a month; at Davos, twenty. During the shortest days of winter there are at Colorado Springs eight hours possible sunshine; at Davos, four and one half hours. Nothing is more remarkable than the psychical effect of the Colorado climate; in the East what may be called the psychical level of the consumptive invalid is one of distinct depression below normal; in Colorado it is one of as certain elevation above it. This feeling of happiness without obvious cause, making living a delight, is the familiar experience of the invalid who has chosen the right time and the right place for his immigration.

Dr. Solly of Colorado Springs, from the consideration of 4,876 cases of consumption of all stages treated at various places by different observers, concludes that consumptives treated in open resorts at high altitudes have three times the chance of recovery as in low altitude open resorts, and twice as good chance as in sanatoria at low altitudes. That is to say, that, though consumption is not a disease amenable to medicines, the consumptive whose habits are regulated by medical advice is more likely to do well than one who has no such care.

It is on the basis of such trite truths as I have detailed, added to the familiar history of certain sanatory institutions in this and other lands, that I venture to propose a plan for the treatment of consumption in its early stages that seems to me to have advantages over any yet realized. No particular originality can be claimed for the suggestion in its essential features, since a somewhat similar outline has been drawn by others, and the practicability of the plan in its most important respects, has already been proved. I would advise the establishment, at favorable points in Colorado, of a series of cottage sanatoria. The cottage plan is eminently the best in its adaptation to the character of the climate, the people, and the disease. The efficiency and feasibility of such an institution has already been established in the Adirondack Cottage Sanitarium of New York, which might well serve as a model for extensive development. These sanatoria should be located at points of various altitudes above sea level from 5,000 to 8,000 feet. They should be located with careful regard to climatological conditions, purity of water supply, beauty of scenery, and accessibility to the railways.

Numbers of suitable places at once occur to any one who is familiar with Colorado; I may definitely specify the neighborhood of Colorado

Springs, several localities within a few miles of Denver, Perry Park, half way between the two places, points to the north of Denver and Estes Park. Certain of these places are habitable all the year around and others best available only in summer. A salaried resident physician should be constantly on the ground for the moral comfort and physical demands of the patient. An unpaid medical sanatory director of known experience, making weekly visits, should have complete direction of the general conduct of the sanatorium. Such medical service could no doubt be obtained gratuitously.

There would be no objection to these communities increasing to the size of villages of 300 or even 500 inhabitants, there being but one single essential proviso, e. g., that all things and acts therein accomplished shall have reference to the benefit of the invalid and the restriction of the spread of the disease. The essential sanatory laws are few, broad, and accepted by all, and physicians at large might send to such an institution their private patients and still keep them under observation. The cottages should of course be constructed with sole reference to their uses and might each accommodate from four to eight persons. An important part of the scheme would consist of a central building with rooms above for the accommodation of the weaker invalids, and with an assembly room and various dining rooms below. Patients who could afford it might be allowed to occupy a whole cottage and cater to a private table. The food for all should be of the best.

The land appropriated to the sanatorium should be extensive; not less than five or ten acres to the cottage, and it should be an object to raise, under proper restrictions, vegetables for the table, and to keep a special herd of milk cows. No effort should be spared to provide out-door amusements, scientific and trivial, of every suitable description. Botany, geology, gardening; with the lighter out-door games; even billiards, cards, reading, work with the microscope under proper conditions, are open to prevent the terrible ennui of isolation. The summer sanatoria distributed in the various mountain parks would offer delightful outings and change of scene. At least once monthly, patients should be examined physically, and as the cases improved they should be sent to higher altitudes which, when well borne, immensely facilitate recovery. Such sanatoria are by no means intended as permanent abodes. The invalid should be turned loose to provide for himself as soon as safely able to earn his own livelihood, and after he has acquired that simple but precious education through which he learns the habits that protect himself and others from the disease. For most favorable cases this time would average from three to six months and includes that critical period when the homesick, helpless sick one drifts a stranger into the hotels and boarding houses of Denver, or Colorado Springs, and often, because of his surroundings, receives a fatal impulse which determines his dissolution. I say no word of absolute *cure*.

Undoubtedly, cases occur in which, after a few months' residence,

under favorable conditions, the invalid may return restored to health to the scenes and occupations of his downfall. But I know no means of ascertaining whether such a cure has been attained, and the humiliating, fatal mistakes made by most skillful medical observers who have let their good will direct their good sense, form a patent warning against such a course. There is, however, a cure which can almost be guaranteed; that this disease may be so arrested as to interfere in no wise with the usefulness or enjoyment of life lived under the conditions establishing recovery. This, then, is at least one great advantage that Colorado possesses over health resorts of the east, that means of earning a livelihood and the chief requisites of a happy existence are to be found almost at the doors of the sanatorium.

Finally, as to the all important question of financial establishment, maintenance, and conduct of these institutions. It would not be hard to show that the country at large would be a great gainer by reducing this yearly sacrifice of 100,000 lives offered in the United States alone, on the altar of the single disease, consumption. I do not see how such sanatoria as I have described could be started and maintained except by private subscription. Let each state and province have its own institution, not as a close corporation, but with friendly relations with all others. Let at the outset, the state or provincial board of health be a body to receive subscriptions and place in proper hands the direction of the enterprise. Money is plenty enough when the good of a purpose is clear. The sole financial restriction which I can conceive is that such sanatoria as proposed must in no way subserve private interests. They should be as near self supporting as possible but must in no way be money making establishments. The certainty of this fact could alone attract the confidence of those in position to make donations. The price of board and lodging at the cottages should be lower than that of the cheapest ranch, say five dollars a week, while, on the other hand, people of means seeking the advantages of the sanatorium, might be allowed to cater for themselves on any scale of expense that would not run counter to sanatory law. Free rooms could be endowed as they are in public hospitals at present.

Establish such institutions on a large scale and it needs no prophet's eye to see a speedy development of our knowledge of the nature and proper treatment of this disease; to see its sufferings eased, its victims rendered fewer, and a multitude of rescued men and women being there born again to new and happy lives.

EXAMINATION OF THE MILK-SUPPLY FOR TUBERCULOSIS IN THE STATE OF NEW YORK.[1]

By F. O. DONOHUE, M. D.,

President New York State Board of Health, and Secretary New York State Tuberculosis Commission.

Among the important functions of the state is that of protecting the people from the invasion of infectious diseases. This is a moral duty, as well as a principle of polity, in all civilized countries.

Statutory enactments for the protection of the public have, up to within a short period, been confined to quarantine, disinfection, drainage, and the protection of potable waters from pollution, through the agencies of boards of health.

In May, 1892, New York state took a step forward in authorizing its board of health to make investigations in reference to the existence of tuberculosis in cattle. Whether the state of New York should undertake such a function of protecting its people from a disease which is greatest in its mortality list, is a question of political economy, which as far as the state is concerned, as shown by the state board of health, and latterly by the tuberculosis commission of the state of New York, must be answered in the affirmative.

The relation of the milk-supply to infant mortality, from tuberculosis, is insisted upon by all health officers who have made it the subject of systematic observation. The statistical proof is almost the only proof that the nature of the case admits of. Animals have been experimentally infected with tuberculosis from milk infected by the bacillus, and to all minds capable of estimating the force of evidence, reasoning from analogy, the proof is conclusive.

To what extent the infection may occur from tuberculosis in domestic animals, especially milch cows, was thought by the state board of health of New York to be well worth study and investigation.

The question, which was the most likely source of infection in infants, causing such high mortality among them, was thought to be largely the milk-supply. There is no difference of opinion now among medical men as to the communicability of tuberculosis from man to man or from animals to man. That milk and its product will convey it has been proven. When it is considered that milk is the principal aliment during childhood and enters largely into the diet for all classes, it is a highly important question.

The statistics of New York state show, that for a period of eight years last past, every eighth death was caused by tuberculosis. Practically no efficient measures were taken prior to this time to restrict its preva-

[1] Read at the Montreal meeting of the Association.

lence, and twelve per cent. of our mortality is justly chargeable to it. No other single disease approaches this as a cause of mortality to the human family; no epidemic, however dreadful, swells the death list to such an extent.

The report of the New York state board of health for January, 1892, gives a total mortality of 17.42 per 1,000; for all zymotic diseases, 3.23; for consumption 1.9; and yet, consumption is always and everywhere the result of a bacillus or germ, and this being the case, it is clearly amenable to restrictive measures, and ultimately to complete extinction.

Prior to 1892, there was in existence in the state of New York, no statute which gave authority to deal with the examination of cattle, to determine the existence of tuberculosis; nor was any other state or country engaged in the examination of dairies for tuberculosis, with the authority of statutory enactment. There was, therefore, no precedent to follow. It is true that boards of health have been empowered to seize and confiscate tuberculous meat, and examine cattle at abattoirs for tuberculosis. The state board of health of New York desired further powers, and with the influence of the present executive, Governor Flower, who took a deep interest in the matter, caused the passage of the act known as the "Tuberculosis Act." This act was passed and signed by the governor in May, 1892, and authorized the state board to inspect cattle within its boundaries, and cause any bovine animal found to be suffering from tuberculosis to be killed.

This law deals with the largest industry in the state of New York. The value of the live stock on farms in the state exceeds that of any other state in the union. It is estimated that about $40,000,000 worth of milk and its product is consumed in New York state every year, and according to the census in 1890, there were nearly 2,000,000 milch cows in the state. It will be seen that the undertaking is a large one; but every work must have its beginning.

The proportion of bovine animals slaughtered for human food which are found to be suffering from tuberculosis varies greatly in different countries, owing, no doubt, to the standard of official inspection. The proportion of tuberculous to healthy bovine animals in 1891, was 6.3 per cent. in the whole of Prussia, and 12 per cent. in Berlin alone. In France, on the other hand, the proportion of tuberculous bovine animals, according to official figures, was less than one per cent. Much of this discrepancy was doubtless proportional to the strictness of the examination.

As regards the conveyance of infection through meat, this has been abundantly proved. The field of infection is most likely to be the stomach, since recent investigations have shown that the bacilli of tuberculosis are destroyed by the sun's rays in a few hours. The danger of infection through the respiratory tract is therefore lessened. The broad fact is established that a tuberculous cow may give tuberculous milk, and will do so if her udder be affected, and if in a given case, a tuberculous

cow does not give infected milk it is only a question of time when she will do so.

The state board of health of New York began the examination of cattle for tuberculosis in Westchester county in August, 1892, by adopting the method known to physicians as "physical signs." The investigations were begun here, because the disease was known to exist in this vicinity. Advanced and well marked cases were discovered and destroyed; but the board and its inspectors were convinced that cases not well marked were left behind.

Soon after Dr. James Law, professor of veterinary science in Cornell university, and now a member of the New York state tuberculosis commission, used Koch's tuberculin in making an inspection of several herds in Tompkins county. By the use of this agent, he selected the diseased animals so accurately that the state board of health was convinced of its value as a diagnostic agent. Others soon made use of this agent with corresponding results. The board soon after adopted it, having become convinced of its innocuousness in healthy animals, and finally no animal was condemned until tuberculin was exhibited.

During the following year and one half, with a nominal appropriation and a small corps of inspectors, the state board of health examined 22,000 cattle, and caused to be killed out of that number about 700. The major part of this work was done in the region known as the Hudson River district, where those large industries in the making of condensed milk are located.

The proportion of tuberculous animals to healthy ones, from these figures, if used as a basis of calculation for the entire state, would be misleading, if taken without explanation. Most of these examinations were made in districts and among herds where the disease was known to exist, and the percentage of diseased animals found is far too high in estimating the state as a whole.

The work of the state board of health in this line met with much opposition on the part of many dairymen, who suffered some pecuniary loss on account of the slaughter of their cattle, and no doubt by reason of the stigma which attached, on account of the publicity, which was inevitable in the daily press, of certain herds being examined by the state board of health; and then, too, while compensation was allowed, so much delay was occasioned by the infrequent sittings of the state board of claims, which tribunal had the authority to adjudicate all claims for damages for the slaughter of diseased cattle.

Experience teaches that all innovations meet with opposition. Every disturbance in the equilibrium of time-honored ignorance is bound to meet with opposition; nor was it to be expected that this line of investigation would be any exception to the rule; moreover, as it disturbed a large industry, and entailed pecuniary loss to the individual.

The matter became the subject of senatorial investigation during the past winter. The work of the state board of health was reviewed by a

senate investigating committee, with much minuteness of detail. The senate committee, after completing its investigation, recognized the fact that upon the report of the state board of health in the matter of tuberculosis, the care of the public health was a part of the continuous duty of the state, and this work, based upon the facts submitted, was not a task to be taken up in a season and afterwards laid aside.

The work of the state board of health, for the time under consideration, evolved the lesson that tuberculosis existed in the dairy cattle to quite an extent, and that special legislation was necessary to deal with it. The facts submitted were unanswerable arguments for creating a commission with authority to exercise continuous investigation. The recognition by the state of its duty of maintaining a department clothed with authority, coincides with the next stage of evolution in the matter of the examination of the milk-supply for tuberculosis. With the assistance of the present executive, Governor Flower, who had been active in his support of the measure from the outset, a special commission was created for the continuance of this work, on the 31st day of May, 1894, with all the powers formerly possessed by the state board of health.

During the short time since the creation of this commission, it has carefully studied, by a system of special inspection, the prevalence and distribution of this disease, the stabling, mode of infection and local conditions, and the disposition of the dairy products, for the purpose of building up a knowledge of the existence and behavior of tuberculosis in cattle, and the work has gained new interest by the striking lessons drawn from field work among the dairies. This commission has been engaged in the work of examinations for tuberculosis, in the eastern, western, and central portions of the state, with the object of determining the distribution of the disease. The small appropriation placed at its disposal precludes the commission from making anything like a complete examination of all the cattle in the state; its aim is rather to determine its prevalence and submit a report of its findings to the next legislature in January. It is now engaged in the Mohawk Valley district, to determine the prevalence of the disease within a given area, and it is hoped a pretty just estimate can be made, taking this area as a basis for calculation.

The commission on tuberculosis in cattle meets with no antagonism now in its work, for two reasons: First, the people are becoming educated to the importance of the work; and secondly, the owners of the cattle are compensated.

Before the cattle are destroyed, if found diseased by the commission, appraisers are appointed, one by the comptroller of the state, and one by the owner of the condemned cattle. The animals are appraised at their sound value, and are then slaughtered; an autopsy is held in each case, and if it be found that tuberculosis exists, the owner shall receive not more than sixty dollars for a registered, and not more than twenty-five dollars for a grade animal; but the appraisal in order to insure this amount must be double the amount stipulated.

The fact that owners are compensated for the loss of their cattle encourages them in the work, and if in a given case suspicion of disease exists the commission is promptly notified.

In the work of eradication of the disease owners of high grade cattle are themselves making investigations, thereby avoiding the publicity which obtains in examinations by the state authorities.

A word as to the methods of examination. A careful history of the herd is first taken by the inspectors; the distinctive breed or breeds; if any animals have died within the past two years; and the disposition made of the milk and its product from the dairy; and if any additions have been made to the herd within the past three years, and from whom and where. Then the initial temperature is taken and carefully recorded. Tuberculin is then exhibited by hypodermic injection. If the American product be used, thirty minims of the undiluted tuberculin is injected in the cellular tissue; if the imported Koch's tuberculin be used, about two minims are injected, diluted. About nine hours after making the injection, temperatures are again taken at intervals of every two hours for the next twelve hours. The febrial reaction in tuberculous cattle, following the sub-cutaneous injection, begins from six to ten hours after the injection, and it reaches the maximum in from nine to fifteen hours after the injection, and returns to the normal in from eighteen to twenty-six hours after the injection. A rise in the temperature on the day following the injection of two degrees F. above the initial temperature should be regarded as an indication of tuberculosis.

The tuberculin test is not infallible. All the diagnostic powers of the veterinarian should be called into requisition in making up his opinion, although but few errors have been made under the direction of the state board of health, and none have been made by the commission on tuberculosis thus far, as shown by post-mortem examination.

One fact has been pretty thoroughly established, and that is that the tuberculin test cannot be relied upon in cattle that are advanced in gestation. These usually give a high reaction, which, if followed, is misleading.

The contagiousness of the disease is established beyond any doubt, for in most cases it can be traced from herd to herd. This has been especially noticed in localities where cattle owners deal with each other in the purchase of cattle from infected herds. In the investigations made, it has not been found that any distinctive breed of cattle has immunity from tuberculosis. Grade cattle have been found to be as susceptible as any other variety.

The lesions discovered on post-mortem examinations are variable from small deposits of tubercles to a quite generally disseminated lesion in the different viscera. In many instances the mammæ have been found the seat of lesions. It would be interesting to make a microscopic examination of the milk from each cow suspected, but for obvious reasons this would be impracticable.

In the hands of the inspectors employed by the state board of health and latterly by the tuberculous commission, tuberculin has proven itself to be a valuable diagnostic agent. In many instances it has been noticed that cattle well nourished give high reactions, and upon condemnation, slaughter, and autopsy reveal lesions of tuberculosis.

In the very nature of things it must take time to eradicate this disease from the dairy cattle. It is confidently expected that future legislation will be enacted, carrying with it an appropriation commensurate with the magnitude of the work.

Were the importance of human ailments measured by the standard of money, there would be small need of a protracted educational process before steps were demanded for checking our annual loss by tuberculosis; for the fact cannot be too strongly emphasized that the care of the public health is the chief duty of the state.

DISCUSSION OF PAPERS ON TUBERCULOSIS.

Dr. J. T. Nagle, of New York.—I desire to add to what I have already said, that the state board of health of New York will undertake the examination of sputum in all doubtful cases, for any physician in the state. The circulars which I have here, and which relate to the prevention of tuberculosis, are formulated by the health department and show the ravages of this terrible malady. The gratuitous microscopic examination of the sputum is made by the bacteriological division, and proper information given as to the result of the examination, whether the sputum contains tubercle bacilli or not. In case of death from tuberculosis, the walls of the premises where death occurs are cleaned with a solution of bichloride of mercury and the floors washed. The little yellow covered pamphlet which I show you on "Disinfection and Disinfectants" gives this information.

A Member.—I would like to ask Dr. Nagle if the statement made by Dr. Donahue is correct with regard to tubercle bacilli being destroyed by the rays of sunlight.

Dr. J. T. Nagle.—Dr. Ferguson has made a great many experiments and is one of the most eminent bacteriologists in New York. He is also our consulting bacteriologist, and no doubt he will be able to answer the question satisfactorily. Personally, I think it depends largely upon the amount of sunlight and the dryness of the atmosphere, with regard to killing tubercle bacilli.

Dr. C. E. Slocum, of Ohio.—It is stated here that a temperature of 102° F. will destroy the tubercle bacillus. Recent experimentation has shown in the case of infected meat and milk that a temperature of 212° will not destroy the tubercle bacillus entirely. A very high temperature is necessary to destroy it. Two hundred and thirty-nine degrees is necessary to destroy this germ in many instances. A temperature of 102° is one in which the bacillus flourishes the best. It has been partially destroyed by an artificial temperature of 103°.

A Member.—Centigrade or Fahrenheit?

Dr. C. E. Slocum.—Fahrenheit is mostly in use in this country. If the doctor meant centigrade he should have said so.

Dr. F. Ferguson, of New York.—I am very glad to say that I was the first to suggest a laboratory in connection with the board of health of New York, and President Wilson—one of the best executive officers in the United States—who was at the head of the department of health, promptly acted upon the suggestion, and at present I really do not know where President Wilson and his laboratory are likely to stop. As you have already been informed, we are now making investigations with regard to antitoxine in the treatment of diphtheria.

The practical point with reference to tuberculosis is this: We do not

know from an examination of the sputum and milk whether the human being or animal is affected with the disease or not. I know that practically in a great many cases of tuberculosis of the lungs we do not find tubercule bacilli in the sputum. I will make the general statement that either in the human subject or in the animal, wherever the material is examined, there must be a typical breaking down in order to get the tubercle bacilli. This may be in cases of tuberculosis of the lungs, if there is any break connected with the trachea or substance of the lung; in cases of tuberculosis of the kidney, if there is any breaking down of the uriniferous tubules. The same is true in cases of either tuberculosis of the bladder, or rectum. If it be in the wall of the rectum, not involving the mucous membrane, the typical bacillus would be present, and we may have to examine these cases again and again for weeks in order to find the germ. Sometimes, after a long series of examinations, we find an immense number of tubercle bacilli, but there is usually a breaking down of the organ affected in these cases. Connected with the board of health of New York, there are twelve of us conducting these examinations.

Other means of conveying tuberculosis may be found in the brushes that are being used in the bath, the barber's brush, etc. I have found every one of them infected with pathogenic bacteria. I verily believe that a source of danger is to be found also in our churches, in the communion cup. I have evidence that pathogenic bacteria will live sufficiently long upon a cummunion cup to be cummunicated from one individual to another during the celebration of that blessed sacrament.

Dr. Benjamin Lee, of Philadelphia.—After listening to the papers on tuberculosis, there is no doubt but that there are two important questions for us to discuss, viz., *first*, the communicability of tuberculosis, and *second*, the necessity for preventing the spread of the disease. I wish to call attention to the fact that in Philadelphia we have an association known as the Pennsylvania Association for the Prevention of Tuberculosis. This association is composed of a very small number of physicians and a large number of applications have been received outside the city and state of Pennsylvania for membership in this association. I only wish to say that the association is only too glad to receive members from all parts of the country. But my object in rising is to suggest that in every city and town in the country there should be established voluntary associations in this line for the prevention of tuberculosis, the object of which is first to convey information to the public upon this important question, and second, to secure proper legislation, to enact laws to be carried out in the same way.

One point on which I desire information is this, Has it been definitely established that the bacillus of tuberculosis found in the human subject and the animal is one and the same? I am not able myself to bring data to answer that question positively. Perhaps Dr. Ferguson can furnish us with a positive answer which I can make use of before the legislature at its next session.

I desire to refer for one moment to the paper read this morning with reference to restricting matrimony in the interest of the public health. Mr. President, in sanitary legislation we must be very careful how we attempt to interfere by any process of law with natural selection and natural affinities which rule nature. As physicians we can recommend, but we must not propose legislation which would influence matrimony.

Dr. Hopkins, of New York.—I would like to second the remarks of the gentleman (Dr. Lee) who has just taken his seat, and to dissent from the theory and philosophy advanced by the author of the paper, with reference to the regulation of marriages among tuberculous persons, and I will base my dissent upon the impression that the paper made upon me. It was conceived in the impressions of the last hundreds of years. It certainly does not reflect the conviction of the present day that tuberculosis is simple a communicable disease, and that it is communicable only by conveying the bacillus tuberculosis to the susceptible. The paper speaks of the fact that the young of tuberculous parents are necessarily brought up in an infectious atmosphere. So far as our practice now is concerned, that it is necessarily the case that the atmosphere of any home shall be infectious by the presence of tubercle bacilli, is not true, for if we know anything about the disease at all, we know that the bacillus of tuberculosis can be easily killed, and that the atmosphere of the home of a tuberculous person may be rendered absolutely free from infection. It occurs to me, Mr. President, that we should not undertake by statutory regulation to prevent people from getting married under the apparently conceived idea that their progeny must be tuberculous, and that necessarily the atmosphere of their homes must be tuberculous because they are tuberculous.

Dr. P. Paquin.—I wish to say in reply to the last speaker, and others who have spoken, that I did not say we should attempt to legislate in this matter. My remarks have been misunderstood. I stated quite the reverse. I insisted in my paper that physicians should be educated more along this line, and further, that it is our duty to instruct parents to restrict, as far as possible, the marriage of consumptives, for I know very well that some practitioners not only neglect this matter, but pass it over under the impression that tuberculosis is not communicable. The ground I took in my paper was that the public ought to be educated to such a degree that they will understand what tuberculosis means, what the consequences will be from one consumptive marrying another; that it brings about new foci for the development of germs, and the children of such people are bound to breathe in an infectious atmosphere. I do not wish to create the impression that it was my desire to affect legislation in any sense whatever, but I simply said the physician and families should be educated in regard to the dangers which arise from the marriage of consumptives.

Dr. G. T. Swarts.—I will say in connection with this subject of tuberculosis that the state of Rhode Island appropriates $15,000 annually for

the destruction of cattle afflicted with this disease. It is one of the particular duties of this association to take up this matter and between the different members of health boards secure legislation to prevent carrying tuberculous animals over the borders into other states that are endeavoring to protect the public. I would like to say that the state board of health of Rhode Island is following in the wake of New York, in that it is prepared to examine the sputum of patients free of expense to physicians.

Dr. F. Ferguson.—Dr. Lee has asked whether the tubercle bacillus found in human tuberculosis and that in the animal tuberculosis are identical. I believe it to be the case. A recent paper written by a German states that there are twenty-nine different varieties of tubercle bacilli in the human sputum. I believe we have to deal with one single bacillus which may change a little bit under various conditions, but which is the sole cause of tuberculosis.

Dr. Ramsey.—I think a source of great danger that has not been mentioned in connection with this disease is the clinical thermometer of the practising physician. It should be rendered thoroughly aseptic. It is frequently not properly handled.

VACCINE AND VACCINATION.[1]

By RALPH WALSH, M. D.,

Director of National Vaccine Establishment, Washington, D. C.

I do not propose to enter into a lengthy review of the history of bovine vaccination, or the arguments of vaccinators and anti-vaccinators, but to state some practical facts belonging to the propagation and use of bovine vaccine.

Doubtless the so called cow-pox, which, in my opinion, is modified variola, has occurred in all countries where the cow exists and variola been present, and has commonly been found on the teats of milch cows because it was carried there by the hands of milkers. The horse, sheep, goat, monkey, and dog are also known to be susceptible.

Possessing most advantages, the heifer is used by propagators. It is generally supposed that the vaccinations are made upon or adjoining the udder. This is a mistake. Propagators vary in the location of the vaccinations, age of animals used, and other details of their work.

Animals with red, or red and white skins are preferred. The scarifications are made by most propagators either upon the side over a space reaching from immediately back of the shoulder to the flank, on the escutcheon, or on the belly between the udder and umbilicus.

When the side is used, the animal is strapped to a tilting and sliding table; when the belly or escutcheon, the animal is placed in a padded trough. The table and trough restrain and fret the animal during the operation. Another and very serious objection is that it is impossible to keep the scarifications upon the side, belly, or buttocks clean. The animal is almost sure, although it may wear an apron, to get its sides or belly in contact with urine or fecal matter in lying down, and the escutcheon is as liable to be soiled.

Some years back Dr. E. L. Pardee, who has charge of the vaccine stables belonging to the New York City health board, devised a plan superior to all others, which I have adopted.

The animal is vaccinated standing, on each side of sacrum posterior to the ilium, while securely held in a pen or stanchion. Thus its position is one of ease, and it frequently nibbles at the hay while the operation is in progress. As the animal never lies on its back, the scarifications come in contact with the atmosphere only. Too much credit cannot be given to Dr. Pardee for devising this humane and cleanly method.

The operation, as practised by me, consists of clipping the hair over the desired space, applying a thick lather of soap, shaving the surface, sponging with hot water, drying with absorbent cotton, and then making the necessary number of scarifications. The lymph is taken from ripe

[1] Read at th Montreal meeting of the Association.

vesicles on another animal, applied to the scarifications, and rubbed in with a sterilized ivory "spade" until the wounds are glazed and each scarification sealed.

The time taken by the vesicles to fully develop varies from four to seven days; it is hastened by a high and retarded by a low temperature. Usually by the end of the second or third day drops of early lymph break through the protecting crusts, and hardening upon exposure, appear like amber beads.

If the temperature be high, as in summer, the lymph should be taken about the fifth day; in winter, the sixth or seventh; later pus may be found.

At the proper time the animal is again placed in the pen, the vesicles opened and all semi-fluid lymph scraped from their surfaces with a sterilized spatula, then washed with boiled water and dried with absorbent cotton. In a few moments after cleansing the lymph will commence to well up from the bottom of the vesicles.

The uncharged ivory points (not bone), when received from the manufacturer, are sterilized by heat and packed in sealed jars until they are placed in the frames. A frame consists of two pieces of hard wood about eighteen inches long and one inch square, secured together sufficiently close to hold the bases of the points. Each frame will hold fifty points. When the frames are to be filled the points are emptied from the jar upon a rubber cloth, from which the packer, after carefully washing his hands with hot water and soap, takes each by its base and places it in the frame. Holding this filled frame by its lower border in the left hand so as not to touch the points, the operator dips a sterilized camel's hair brush into the lymph and applies it to each point until all in the frame are charged.

When the charged points are sufficiently dry the frames are loosened by reversing the screws with which they are secured, and the freed points dropped into jars prepared to receive them and sealed until packed for shipment.

It will be noticed that the pointed or charged end of the point is not handled during any of the manipulations described, and this rule is followed during the process of packing for shipment; also that soap, boiling water, and dry heat are depended upon as sterilizers.

The effect of the vaccination upon the animal is not marked until about forty-eight hours have passed, then the temperature rises from a normal of 101 about a degree a day until the evening temperature on the fifth or sixth day reaches about 105. At this time the glands in the flank are usually the size of a hen's egg. The animal suffers thirst, lies down a greater portion of the time, and rapidly loses flesh. In six or eight weeks after the operation she is herself again, and no permanent injury in any way ensues. A statement was published some years back in the National Board of Health Bulletin that vaccinated animals escaped pleuro-pneumonia during an epidemic in New England.

Steers are as good subjects for vaccination as heifers.

The color of the lymph varies. That from a Holstein is colorless, and may be applied layer upon layer, drying each layer as applied, yet the point will show nothing but a gloss when turned to the light. That from an Alderney will have a decidedly yellow tint.

Some years ago I vaccinated a registered Alderney, secured a beautiful "take," filled orders from all points of the compass, and had most of them returned to me by angry doctors with the assertion that they were "yellow, full of pus, and unfit for use." I have also had points heavily charged from the Holstein returned with the complaint that there was "nothing on them."

The number of points charged from an animal varies. After the lymph has run from the vesicle for a time it shows a tendency to glaze. I believe this to be the time to stop, but should the propagator be dishonest enough to apply a clamp, he can charge points almost indefinitely.

I believe the fluid lymph dried upon ivory points to be the most practical form of vaccine now used. Lymph in capillary tubes, or that which has been dried and packed or mixed with glycerine, is not adapted to rapid vaccination. Crusts which have gathered foreign, probably septic material during the process of drying on the animal are unfit for use.

The most recent published experiments tending to show the unity of variola and cow-pox, and to throw light on the bacteriology of vaccine, were made by Dr. S. Monckton Copeman at the pathological laboratories of the Brown Institute and St. Thomas's Hospital, London, and published in the May, 1894, number of the *Journal of Pathology and Bacteriology*. Having found by a series of carefully conducted experiments that the monkey is susceptible to variola and vaccinia, he determined to ascertain the protection a previous vaccination of the monkey afforded against small-pox, and also "to compare the effect produced by the use of human and calf vaccine respectively." He made very careful selection of human, calf, and small-pox lymph, and performed experiments at intervals of from one to fifteen months after the primary inoculations. Briefly stated, he selected nine calves, three he successfully vaccinated with human lymph; one of this lot he revaccinated with calf lymph, one with variolous lymph, and one with human lymph. There was no result from these revaccinations.

He then successfully vaccinated three others with calf lymph, and revaccinated one with calf, one with variolous, and one with human lymph. No result from the revaccinations. The last three he vaccinated with variolous lymph, revaccinating one with human, one with calf, and one with variolous lymph. No result from the revaccinations. One calf primarily vaccinated with variolous lymph was afterward twice revaccinated, first with human, and second with calf lymph. No result. Referring to his work, Dr. Copeman says,—"In no one of these experiments did anything in the nature of a successful result follow the first or subsequent

revaccinations, although in one instance the experiments lasted over a period of fifteen months."

From these experiments it would appear that the protective form of lymph, obtained from these three different sources, when inoculated on the monkey, is practically identical in all respects.

Ceely records one instance where five out of eight cows developed cow-pox from twelve to fourteen days after they were seen licking bedding upon which a patient had died of confluent small-pox.

The director of the Swiss Institute has recently published a work entitled "Variola-Vaccine, wherein he gives an account of eight successful series of inoculations upon the calf with variolous lymph from the human subject. Some of these series were carried from calf to calf as far as the seventh remove. "With the lymph of the fifth or sixth remove a number of primarily unprotected children were vaccinated with unfailing success. The resulting vesicles could in no way be distinguished from ordinary vaccination vesicles of equal age."

Dr. Copeman reports the successful inoculation of a calf with variolous lymph, August 11, 1892. He ran it to the third remove, and could not succeed in revaccinating either of the animals inoculated. "For reasons of economy the series was not continued further."

I do not think we can ask much stronger proof of the unity of variola and cow-pox than this recent testimony so ably presented in Dr. Copeman's paper.

Referring to the bacteriology of vaccine we find that Copeman, Professor Crookshank, Pfeiffer, and many others, though working independently, have arrived at the same conclusion, "that although numerous bacteria can be grown in various nutrient media from specimens of vaccine lymph obtained in the ordinary way, to none of these could be assigned the role of the actual vaccine virus, which, as yet, remains unidentified."

Dr. Copeman has applied the term "extraneous" to the specimens of bacteria found by him, because their presence is in no way necessary to the successful action of vaccine lymph. He also states that "it is on record in one instance at least, that the streptococcus of erysipelas has also been isolated from a specimen of vaccine lymph."

Now, in my opinion, appears the most important fact presented. In searching for an agent that would destroy the "extraneous" organisms without injury to the actual contagion of vaccine, Dr. Copeman discovered that the admixture with the lymph of a certain proportion of glycerine would unfailingly accomplish the purpose. He says,—"Not only is lymph thus treated efficient as vaccine in the old sense of the word, but as time goes on, instead of losing its effect on inoculation, its potency actually becomes increased." In proof of this he cites the statement of the director of the Health Bacteriological Laboratory at Rome, that Dr. Kreiger mislaid a bottle of calf's lymph, which had been treated with glycerine, found it eleven years after, produced normal vesicles from its use,

and passed the lymph from them through other subjects. Finally Dr. Copeman states that glycerine appears to inhibit the development of the streptococcus of erysipelas.

If the admixture of glycerine with vaccine lymph will destroy all "extraneous" bacteria without injury to the activity of its peculiar manifestations, and preserve such action for long periods of time, we have gained all that is necessary in vaccine lymph, and it only remains for the ingenuity of the propagator to devise a method for its convenient use in rapid vaccinations.

There has been some dread of the conveyance of tuberculosis from the animal to man through vaccine lymph. I have been unable to learn of a single reported case where tubercle has appeared at the point of vaccination, or where tuberculosis has resulted from vaccination. All bacteriologists with whom I have conversed say there is little or no danger.

The selection of lymph and the operation of vaccination has not received from the profession at large the thought deserved. States and municipalities pass vaccination laws; state boards of health discuss; medical societies read papers and pass resolutions; a few practitioners write articles for the journals; yet professional negligence or indolence permits the unvaccinated material to surely increase until a case of small-pox sets a community wild. Then there is a rush to the drug store for vaccine, and the authorities look about for the cheapest lymph. The lowest bidder most frequently gets the trade of the local health officer, and the practitioner takes anything the druggist offers. The lymph used to protect those who have come in contact with the first case may have been held for months in stock by the druggist and be inert; thus, at the most critical moment, no protection is given. In due time other cases occur, and new centres of infection are formed. The anti-vaccinationist starts his cranky crusade, the scare extends to neighboring communities, and a quarantine of terror paralyses trade. This is not an overdrawn picture of what has occurred in many places in the United States during the past year. During such scares vaccinations are hastily performed, and often there is no after inspection. The lymph used may be feeble, or the operation badly done. The latter varies at the hands of ignorant practitioners from the attempt to pick the lymph into a single pore to the crucial incision extending to the fascia. In one case the lymph does not reach the absorbents; in the other, the hemorrhage washes it out or a sloughing ulcer lays bare the muscle; in either case, the vaccine is blamed.

What are the remedies for these conditions?

An honest observation of responsibility upon the part of the propagator of vaccine and the physician who should use it.

It is incumbent upon the propagator to select carefully his animals, observe great cleanliness in his stables and operating room, use aseptic methods so far as the safety of the lymph will permit, ship only fresh and active lymph, and protect it in shipment as thoroughly as possible.

Here his responsibility ceases. He cannot control the vaccine after it enters the mail or express car.

The physician should see that each infant brought under his care is successfully vaccinated during the first year of its life, and at least again at sixteen. The ideal protection can be secured by vaccinating to the point of saturation; I mean, to vaccinate at six months of age, or earlier, and then each succeeding six months, until no result is obtained, making test revaccinations at intervals of a few years thereafter. The lymph should be used direct from the propagator, holding him responsible not after it has passed through the hands of second and third parties and all responsibility lost. Public health associations, state boards of health, and local health officers are all doing active work; but until the practitioner at large strikes at the root by cutting off unvaccinated material, we may expect to have a continuation of destructive outbreaks of small-pox.

In conclusion, I summarize as follows:

So called cow-pox is simply modified variola.

The admixture of glycerine with vaccine lymph will destroy all "extraneous bacteria" without injury to its peculiar active principles.

The admixture of glycerine with vaccine lymph not only destroys the "extraneous bacteria," but prolongs the activity of the lymph.

The selection of lymph and the simple but important operation of vaccination have not received from the profession the attention deserved.

The physician should see that each infant brought under his care is successfully vaccinated during the first year of its life, and each child again at sixteen, or better, to the point of saturation during infancy.

The accumulation of unvaccinated material, and consequently the increased danger of outbreaks of small-pox, are caused by the general practitioner neglecting to perform his duty at the proper time.

DISCUSSION.

A MEMBER.—Is it not occasionally that vaccination results in the formation of a red wart within two weeks after it has been performed? What do you consider the cause of that?

DR. WALSH.—That question has been frequently put to me. In my opinion, it is due to weakened lymphs; either that the lymph has been flowing too long from the vesicle, or caused by age, or coming in contact with overheated cars in transit. I know of no other explanation.

A MEMBER.—What do you do with the wart?

DR. WALSH.—It soon disappears.

DR. ROBINSON.—The subject of the raspberry appearance of vaccination I think is due to rupture of the smaller arterioles having taken place, owing to improper application of the vaccine virus. It is non-protected; and the best way to revaccinate upon the site of the raspberry appearance, or wart, as it might be termed, is not to cut too deeply because you will have too much hemorrhage. I have had a great deal of experience in this particular line of work.

ON THE CULTURE AND COLLECTION OF VACCINE VIRUS.[1]

By L. E. GAUVREAU, M. D.,

Director of the Provincial Vaccine Institute, Quebec, Canada.

The practice of animal vaccination has for its object the uninterrupted culture of the original vaccine (cow pox) upon animals of the bovine species, and the utilizing of the same as a preservative against small-pox. The vaccine obtained by this method of animal culture is endowed with preservative qualities seemingly equal to those of human vaccine; and it moreover affords guarantees of absolute purity which cannot always be expected from the latter. As our American neighbors have recently suffered from an epidemic of small-pox, we have thought that it would be useful and opportune to describe, as briefly as should be consistent with clearness, the methods and processes of animal vaccination.

The method generally adopted until a few years back, was the following: Between the fifth and sixth days from the inoculation of the heifer, when the pustule has matured, the operator, with a pair of Chambon's Lannoix', or Belluzi's pincers, presses firmly the base of the vaccine pustule, in order to extract therefrom the greatest possible quantity of lymph. This method has been followed by Negri, Lannoix, Depaul, and Worlomont. Experience has shown that the above method was defective, since, in compressing the pustules, as was generally done, there escapes, together with the lymph, blood, minute particles of tissue, and sometimes pus, when this compression was exerted several times upon the same pustule. This repeated compression produced hyperaemia in the part operated upon, and, as a consequence, advanced the stage of suppuration, which should normally take place only between the sixth and seventh days. And, indeed, if we examine the vaccine thus collected and laid on the ivory points, we find that it has a dark yellow color, which is a certain indication that this vaccine contains foreign substances. To-day we proceed in an entirely different manner, and the results obtained therefrom fully justify this new mode of culture of the lymph. In the first place, the whole operation is conducted upon the strictest antiseptic principles: the stables, the heifers, the points, the instruments, the hands of the operator and his assistants are sterilized. The heifers must be young animals in perfect health, from three to twelve months old. Light red or white heifers are preferable to those of a darker color, inasmuch as the latter, owing to the large quantity of pigment contained in the epidermis, are often difficult of inoculation. Heifers are very seldom attacked by phthisis before the age of twelve months, and even were they so, there would be very little danger of

[1]Read at the Montreal meeting of the Association.

transmitting the disease by variolous inoculation, a fact very clearly established by Mr. Strauss in a remarkable work, of which we shall only mention the conclusions. Says Mr. Strauss:

"Tuberculo-vaccinal infection is not probable, and even almost chimerical, and this for a number of cumulative reasons, which can be summed us as follows: 1. Owing to the age of the vaccinated animals, the younger ones are very seldom tuberculous, and hence cannot transmit a disease with which they are not themselves affected. 2. Even where the heifer is phthisical, the serum of the vaccinal pustule would still run the strongest chances of not containing the tubercular germ. 3. If, nevertheless, through an impossibility, the vaccine used contained a tubercular germ, the mode of insertion adopted, the slight depth of the vaccinated wound, would also prove eminently unfavorable to the development of the germ. The animal to be inoculated must be in good health, and must have been examined by a veterinary surgeon first before the inoculation, and again at the moment of collecting the lymph. The heifer must be brought to the stable at least twenty-four hours before the surgeon's inspection, as it sometimes happens that after a journey more or less long and fatiguing, the animal appears depressed and languid; but this condition does not always imply the existence of disease, and rapidly disappears after some hours of rest."

The inoculation of the heifer comprises a series of operations of which the following is the order: 1. The skin is shaved at the spot selected for the purpose. 2. The surface is scarified. 3. The vaccine is inserted in each of the scarifications. To perform these operations it is necessary that the animal be previously bound, so as to be motionless, and after the shaving the spot is washed with an antiseptic solution of bichloride of mercury, and wiped with a sterilized cloth. Between the fifth and sixth day after the inoculation, when the pustules have reached maturity, the operator presses lightly upon them, in order to rupture the membranes. Within a few hours the lymph begins to flow in large drops, white, and very limpid. These drops are received by the operator upon a small camel's hair brush, which has also been previously sterilized, and are by means of this brush transferred to ivory points fixed into an instrument of which the following is a description: It is composed of two wooden rods, lined with rubber bands. These rods are held together by means of screws, which are tightened at will to keep the points in position. The rods are three feet long, and hold 150 points. A person used to the work generally takes five minutes to supply the rods with points, and two or three minutes suffice for the physician to coat these 150 points with lymph. Heat and cold have a marked influence upon the evolution of the pustule. In warm weather the lymph may be collected on the fourth day; whereas cold retards it—so much so that in winter sometimes the collection of it is only made on the sixth day. It may be well to add here that the evolution of the vaccine pustule is more rapid in the bovine than in the human species. As a general rule the

eruption in the animal is completely developed, and the lymph may be utilized after five times twenty-four hours.

Until late years in no work treating of the culture of vaccine lymph do we find any mention of asepta; whereas at present, as I have just said, everything is done from an antiseptic standpoint.

The instruments are also sterilized before and after each scarification, by being passed through the flame of a lamp. As regards the stables, the best disinfectant, in our opinion, is whitewashing, repeated as frequently as possible.

The ivory points and the rods which hold them are also heated in a special oven to a temperature of 215° F. before being charged with lymph. The hands of the operator are carefully washed and plunged into a solution of bichloride of mercury before scarifying, and also at the moment of collecting the virus. The temperature of the animal is also taken by the veterinary surgeon, both at the time of the inoculation and when the lymph is collected.

The best means of preserving the charged points is to place them in a vessel with a glass stopper. Those which are to be delivered to the trade are put up in nickel or brass tubes, each tube containing ten points. The tubes are filled by means of a forcep, so that the hands of the operator may in no case come into contact with the points. Before being put into the tubes that portion of the points which holds the lymph is wrapped in sterilized cotton. When the points require to be transmitted to any considerable distance, the tubes are surrounded with tinfoil, over which a fold of rubber tissue is wrapped and sealed by the application of heat. The vaccine thus packed can be kept for a very long time, being protected from dampness, the greatest foe to its vitality.

With respect to the double charged points advertised in certain circulars, we do not see the utility of charging a point with lymph from two heifers. In effect, if the vaccine of any one heifer is doubtful, it is better not to use it at all; if it is good, then it alone is sufficient, since the smallest quantity of reliable lymph suffices to produce an eruption having every desirable characteristic, and an over charged or double charged point may contain too large a quantity of virus, and produce an inflammation which may lead to regrettable results.

We trust that the foregoing brief notes will suffice, without entering into greater details, to show that when the whole series of operations is conducted upon strict antiseptic principles, no harmful results are to be apprehended from vaccine so collected, provided that the physicians afterwards, in performing the slight but important operation of vaccinating the child, neglect none of that care of cleanliness, nor of those antiseptic methods so scrupulously adhered to by the practitioner in every great chirurgical operation.

A PLEA FOR ASEPTIC VACCINATION.[1]

By M. T. BRENNAN, M. D.,

Pathologist Laval University, Professor of Hygiene in Jacques Cartier Normal School, School Commissioner for City of Montreal, etc.

Vaccination, being the inoculation of a virus, should be performed with all the precautions calculated to insure the action of the pure lymph, free from all contamination, and the action of it alone. This is not always realized. It should be with this inoculation as with all other operations, such as experimental injections, hypodermic medication, surgical measures, and so on. It should be performed in the most aseptic manner, in order to obtain the real desired effect, with the least possible danger to the subject operated upon. What would be said today if an operator worked in a bungling manner, with soiled hands, and infected instruments; or if a bacteriologist did not take every means to insure pure cultures and correct results? It is even so with vaccination. To insure success and a minimum of danger, all outside infection must be prevented. It is still more important in this case, as the subject experimented upon is not an ordinary animal, but a human being possessed of rights that should be respected, and of a life that must not be thoughtlessly exposed.

Two things should be kept in mind to carry out this *desideratum*: 1. the vaccine furnished should be absolutely pure; 2. the operation should be done antiseptically.

Let us peep into those two dark corners.

Pure lymph.—It is especially urgent that it be fresh and pure, produced and gathered under the most careful precautions. The lymph-producing establishment should be a superior, high-toned bacteriological laboratory, where no other germ but that of vaccine should dwell; her servants should be scrupulously clean and vigilant, keeping far aloof all evil-working organisms; should those be present they should be "cooked," "sublimated," "exterminated," on the spot. Disinfection is urgently called for in its smallest details, and should be successful. The points, or tubes, etc., destined to receive the lymph, should be thoroughly sterilized; the boxes, or cases, in which these are put up should also be pure, and hermetically sealed—paraffined, or otherwise safely closed. The tubes should be handled with clean hands only; and, above all, the *points* should not be touched by any other than the operator, who, when about to use them, should see that they are kept uncontaminated. Before being delivered to the vaccinator these points should be, from time to time, submitted to a bacteriological test in the municipal laboratory; such wise precautions have been taken in several places, notedly in France, and surprising results have followed.

Great "wee" things have been found where antiseptic culture and

[1] Read at the Montreal meeting of the Association.

gathering were said to have been employed; here the test gently said, "No—insufficient—a fault somewhere along the line—put up a semaphore with a red light! There is danger ahead!"

Those measures will insure a pure virus. I now come to the second point, the *operation*. Before considering it, I may be permitted to drop a R. I. P. on the "crust" vaccine, still employed by some "crusty," hard-to-convince practitioners. It may be all very well, very aristocratic and noble, to be inoculated with Adam's crust, to know that several generations have had a mite of it buried under their skin, and that it was religiously gathered on the calf of a great-great-grandmamma, when she was a tiny, healthy baby. Unfeeling microbes care nothing for aristocracy and noble sentiments. Give them something to feed upon, and a suitable abode, and be it a princely coat-of-arms they will soon transform it into an infected and death-dealing medium. A crust cannot be kept for weeks, still less for months, without danger.

The operation.—The operation should be done under strict antiseptic measures; all instruments, dressings, hands, etc., should be clean and pure.

The lancet, scarifier, needle, etc., used to abrade or incise the skin should be sterilized *before* and *after* each vaccination. Before operating the skin should be disinfected with sublimate, 1-1000 or 1-2000, and dried with aseptic cotton.

The method of simple abrasion, though a trifle more tedious and lengthy than scarification, appears to me to be the one less fraught with danger, and giving the best results. I would suggest, although I have not yet tried it sufficiently, a method of injecting the diluted lymph hypodermically; I believe it would simplify the operation, and give more satisfaction.

The less blood drawn, and the smaller the inoculation spot, the better; there is less blood and other matter to decompose and favor the development of extraneous germs.

The little operation ended, cover the surface lightly with antiseptic gauze till the spots are perfectly dry; then dress with sterilized gauze, or aseptic collodion, although I do not advise the latter except for very restless, indocile children.

Having always taken the above mentioned precautions since our last small-pox epidemic, in 1886, I am far more satisfied with results. I have noticed less constitutional disturbance, less local inflammation, less, or no glandular swelling, and less skin eruptions. I firmly believe that the greater part of the accidents attributed to vaccination are due to contaminated lymph and unclean operating. When the vaccinating is done antiseptically and accidents follow I think we may safely assert the presence of foreign germs in the lymph. Vaccination, with proper care, is a benign operation, and by attending to its requirements I feel sure all the discredit thrown upon it will rapidly disappear, and it will require no law nor any force to insure its universal application.

We have no right to endanger the life of a person, or to expose his or her health to any disturbance, when we possess means of avoiding it.

It requires no large armamentarium, nor increase of time to do things rightly.

Each vaccinator should be provided with: (1) pure lymph, of a standard strength if possible, conserved antiseptically; (2) a vial of distilled or boiled water to dilute the lymph; (3) a vial containing a solution of bichloride of mercury; (4) a small alcohol lamp to sterilize the lancet, etc.; (5) some sterilized absorbent cotton, and (6) some sterilized gauze.

All those take up but small space and may be placed in a handy little satchel or metallic case.

I close, craving the indulgence of the honorable members for my short and imperfect paper; but beg their support in favor of the feasibility and necessity of pure, immaculate vaccination. Gentlemen, my thanks for your honorable attention.

THE DOMESTIC DISPOSAL OF GARBAGE.[1]

By N. E. WORDIN, A. M., M. D., Bridgeport, Conn.

As I have visited some of our larger cities of late, nothing has so much impressed me as the moving masses of men. At early day surging into the business centres, at evening they crowd and jostle to find rest after the weary toil. Every means of transit is used and all are crowded. The tendency of population to aggregation, the growth of the city at the expense of the country is not only a surprise, so marked is it, but it brings serious questions for consideration. The statement is made that more than one half the population of the United States is found in cities of over ten thousand, while there are towns in every one of the New England States which do not number more than they did in the days of the Revolution, one hundred and twenty years ago.

The question of how to govern our cities, how to deal with the living crowd, becomes a prominent problem of our time. How to secure *at all* the expression of the popular will, to maintain the purity of the ballot box, to prevent ring rule, to avoid wickedness in *high* places if it cannot be prevented in the low, to guard against corruption in office, to secure the enforcement of the laws with equal and exact justice to all, to provide for the poor who are always with us, and the discontented whose only law is self, to properly educate the young in morals, in patriotism, in a love for study to protect the schools, the Palladium of our citizenship, from political or sectarian interference, to protect the life, the health of all from the dangers of crowd-poison, of contagion, of filth, are some of the difficulties which beset the city fathers who are wise. Ethics, sociology, hygiene, civil liberty, political economy, each contributes its part.

Civilization, the elevation of humanity, strange as it may seem, is in danger of refining us off from the earth. And still, each civilization is continually being improved upon. Each step in advance of the savage condition imposes heavier burdens upon us and brings continued dangers. The savage, the primeval settler, the pioneer, can leave their waste behind them and find continually fresh fields and unpolluted air. A sparsely settled country maintains its denizens with little liability to epidemics or contagion. The aggregation of people, the growth of cities, brings to the sanitarian, the scientist, the philanthropist, many problems of the prevention of disease.

The one which I would briefly consider now is the *final* disposal of garbage. By garbage I mean "offal or refuse matter in general; especially the refuse, animal and vegetable matter, from a kitchen." It is taken for granted that we all feel the necessity of considering this question. To quote from noted sanitarians, "All diseases due to the putrefaction and

[1] Read at the Montreal meeting.

decay of animal and vegetable matters are mere expressions of unsanitary conditions which may be wholly avoided."

"It is seen that many diseases come from matters of an animal or vegetable origin which may be directly derived from organisms by certain processes of change such as occur in putrefaction." "People who are living in the midst of general unsanitary conditions are in a worse plight than people living in the crater of an extinct volcano; for not only may any one of the severest epidemic diseases break out among them at any time, but they are continually sacrificing unnecessary victims to the demon, filth." "In answer to the question, 'What chemical means and agents, then, are to be employed for the prevention of infectious diseases?' The general means include cleanliness, the studied exclusion of putrescible matters and processes in and near human dwellings, and a due provision of pure air and water. Every medical practitioner and every sanitarian, irrespective of theories as to the causation of preventable diseases, is assured of the help which filth and unsanitary surroundings give to contagious illnesses." "It may indeed be taken for granted that the whole experience of the world in all ages goes to show that much preventable disease originates in the putrefaction of animal and vegetable matter going on in the midst of human habitations."

The necessary elements of life are at the same time the necessary agents of death, and how can we evade their bad influence if we cannot live without them! Hygiene, which to-day analyzes and defines their good and bad conditions, gives us the key of health and constitutes an unbreakable barrier against illness. Its apostles are the guardians of the redemption of the human species. They preach everywhere, in families, in society, and to the individual the scientific creed which in their midnight studies has been revealed to them by noble, generous, and divine science, which they have conquered and are divinely entrusted with.

Less attention has heretofore been given to the disposal of garbage than to some of the larger products of waste such as sewage, because the larger demands immediate action and the question is decided promptly. The garbage of a small population is easily disposed of. It can be either used or buried. But as it increases in quantity, its disposal grows to be a serious question and is now confronting the authorities of our cities. I propose to answer as briefly as possible the question, what shall we do with our garbage?

In towns and smaller cities it is fed to hogs or to cows. But when we think,

> "Great Cæsar dead and turned to clay,
> Might stop a hole to keep the wind away;"

that these animals, our food, are but transformed swill, we may well hesitate. We know now that the quality of the animal is quite largely determined by the character of its nourishment. This is true of man as well as of the lower animals. We have read of the horrors of swill-fed cows, thin and hide-bound creatures whose milk is blue and watery, whose flesh

is badly nourished and diseased. Societies for the prevention of cruelty to animals no longer permit such things. The best dairies are those which pay greatest attention to the care and feeding of their creatures. The causes of disease are being very closely studied in these days. As one result, it is ascertained that swill-fed milk increases infant mortality.

In one New England city forty-two per cent. of the annual mortality was infants, and an examination of the dairies supplying milk for that city proved that a very large per cent. of the garbage sold by the city to the dairymen was regularly fed to cows, and the milk from these cows, fed to infants, produced the result just stated.

But the pig,—what of him? Surely he was made for just such things. Verily the sow that was washed returns to her wallowing in the mire. Swine and swill are alliterative, euphonious, and go well together. It was into the swine that the evil spirits went at Gergesa in the time of the miracles and it was to the swine that the prodigal went in his extremity and despair. And the pig is now just the same absorber of things vile as when the Gospels were written. Feed garbage to swine, of course—"he hath never fed of the dainties that are bred in a book; he hath not eat paper, as it were; he hath not drunk ink; his intellect is not replenished; he is only an animal, only sensible in the duller parts." Feed garbage to swine, of course—but what will you do with such swine? To sell them for eating is to sow the seeds of disease. For cholera and trichina, germs and worms, are only two of the diseases which characterize this animal. Fish, flesh, and fowl take flavor from the food on which they live. No choice breed of anything is raised on refuse. Moreover, the hog is one of the animals most prone to trichina. The trichina spiralis which was formerly regarded as an accidental and innocent inhabitant of the muscular tissue, has been unmasked since the first observation of Zenker in 1860, on a servant girl in the hospital in Dresden, as one of the most deadly of all known parasites. Professor Dalton says the only animals in which it occurs spontaneously and frequently are the rat and the pig, and the latter has been the source of infection for man in every instance thus far known. Experience in New England has shown the increase in cases of trichinosis to be, in three years, from three to seventeen per cent. among hogs fed with garbage of the city of Boston and an annual mortality caused by hog cholera at other places in the state where city garbage is used for food for swine is so great that measures are about to be taken to prohibit the feeding of any city garbage to swine in Massachusetts. It makes the value of garbage none the more to think that it is not even fit for pigs, the filthiest of all animals eaten by man, and the question still arises, what shall be done with it?

It may be thrown into neighboring lakes, rivers, or ocean. But that cannot be done excepting in large bodies of water. In the case of a running stream it would be only another case of river pollution. And the cry is now to save the fouling of our streams. Into the Mississippi river eight cities alone deposited during the year 1888, 152,675 tons of gar-

bage, manure and offal, 108,250 tons of night-soil; more than 260,000 tons—beside 3,765 dead animals. Into the Ohio river within the same period, five cities dumped more than 57,000 tons of similar material and 5,100 dead animals. Into the Missouri river, within the same twelvemonth, four cities alone put 57,500 tons of refuse, and 31,160 dead animals. Not even the Father of Waters could long endure such defilement; it would become a Lethean stream. Recall the fact that a large proportion of these animals have been killed because they were suffering from glanders, farcy, hog-cholera, hydrophobia, pleuro-pneumonia, and tuberculosis, multiply these figures by the lowest possible multiple, and add to this great mass of decomposing material, some thousands of miles of sewage discharged into these three rivers, and the mind can form some dim conception of the degree of their pollution. No theory of the self-purification of running water will suffice to dwarf the magnitude of this sanitary crime.

It may be buried—and some cities actually make a practice of so doing. But this is not a final disposition. Garbage carries, and is fertile soil for, the growth of the germs of all kinds of disease. The ground nourishes these germs; it does not destroy them. If the garbage is not thoroughly buried, if any of it is left upon the surface, it dries, the germs dry, and may be wafted by the breezes to bear fruit some sixty, some an hundred fold. "What shall be said of communities, ranging in population from 10,000 to 100,000, which boast the possession of fifty or more acres of land just inside or outside their corporate limits, upon which they dump, or bury, in closely planted shallow pits, thousands of tons of night-soil, garbage, offal, and dead animals? The human cemetery, fraught with peril to the purity of air, and soil and water, and destined to endanger life and health as a spreading population hems it in, is innocent in comparison with this." Besides, what could be done with such disposal in a city like Montreal, where the toboggan, the snow-shoe, the hockey ball, the curling-stone are characteristic amusements, and where the ice-palace sparkles in the sun, and Winter holds high carnival?

Garbage is a constant quantity. Its supply does not stop when there is no longer a means of disposing of it. But what is to be the future health history of a community whose building-sites are honey-combed with these deposits—what of the soil and the water? To come down to a less important matter, what will be the value of corner lots, when the city's growth brings them into market?

Garbage must be disposed of, somehow. It is a disease-producing nuisance, a decided evil. How shall we dispose of it?

My first answer is, burn it. Fire is the best, the most reliable disinfectant, where articles may be destroyed. The refiner's fire is better than the fuller's soap, in antisepis. The Greek word πυρ, is the origin of our pure. "After all has been said and done in favor of all other means of ridding ourselves of the waste products of city life, history repeats itself in the suggestion of fire as the only competent agency at our command. For

ancient civilizations and yet older pagan people, long since arrived at the same sanitary conclusion to which we have come. In a great part of Asia and South America the fire is still employed to destroy both the remains of the dead, and the refuse of the living. The Jews cremated the victims of the plague in the vale of Tophet; and outside the walls of Jerusalem they cast their offal, garbage, and dead animals into the unquenchable fire which burned perpetually in the pit of Gehenna, three thousand years ago."

But garbage contains seventy-five to eighty per cent. of water, which is the antidote to fire. It accumulates at the rate of one and one quarter pounds per capita daily, 125 tons for 200,000 tons of such material daily is the amount a city such as Montreal, for instance, would have to dispose of. How is it possible to do it? Just here Science comes to solve the problem, as she has done so many others in this age of wonders, and has furnished various forms of furnaces. The Engle Cremating Company, The Davis Cremating Furnace, The Rider Garbage Furnace Company, The Mann Crematory, all of the United States, The Nelson Town's Refuse Destroyer, The Bee-Hive Destructor, The Fryer Crematory, The Wilkinson Furnace, The Healy Patent Destructor, of England, are some of the companies and apparatus for destroying garbage, night-soil, sewage, and every kind of refuse, by fire. Under whatever name, the principles aimed at in all these are the same. The best results are obtained by cremating on a large scale, and maintaining a constant high temperature; by so arranging that surface-heat may be utilized in drying material on its way to the chimney, thus destroying all possible odor, unpleasantness, and absolute danger.

There is another method of final disposal, known as the reduction process, which has the merit of leaving the residue in such form that it can be utilized. The Merz Universal Extractor and Construction Company, New York, and the Simonin Process, of Philadelphia, are the two competitors in this method. The residue is ground and finds ready sale as a fertilizer. I am not recommending any particular method. It is for each city to make its own selection, different circumstances influencing each case. But it might be incidentally mentioned, that if a city possessed a crematory plant, where the work is going on constantly, without cessation, by means of a continual supply of garbage, the city would have a power for the production of electric light, at no cost; or, this power might be sold for a considerable sum, steam boilers to utilize the heat obtained from the furnace having been attached at a very small cost.

Many cities have adopted one of the methods of which I have spoken; many more are considering the subject.

But still, the question of collecting properly is a difficult one to solve. The garbage collector is necessarily a person who has not much idea of cleanliness. He leaves a filthy bucket, and spills outside some of its contents. He is not regular in his visits. There is dissatisfaction with every contractor. A daily collection is necessary where heat is used. In order to secure the best service, contracts should be made for a long time. In

Providence, R. I., it is five years. That should be the shortest limit. Short contracts involve too many uncertainties, and permit too much interference by politicians. In Alleghany City, Pa., each family pays a collector a certain sum per week for collecting its own garbage. But this is found unsatisfactory, as people resort to every means to get rid of the garbage, so as to avoid paying for its collection.

In my opinion, the true method is for each one—each family—to care for and dispose of its own filth. All the trouble comes from trying to put it off on to some one else. "By the use of the domestic garbage cremator, we entirely dispense with the garbage bucket, and all its attendant evils and dangers. We save the cost to the city of carrying the garbage away from the house and disposing of it. We conduce to public cleanliness and health in the most approved manner. The only expense is that of the machine. No extra fire is necessary. No garbage is formed, because the refuse is thrown into the cremator as the plates are cleaned, before fermentation, when no offensiveness is possible."

Unfortunately, no domestic cremator has yet been invented which answers well all purposes. The introduction of oil and gasoline stoves, used so much during the summer, renders useless the kinds which have already been devised. When the importance, the value, of the domestic disposal of garbage has been shown, the inventive genius of the day will certainly find some good and cheap appliance for accomplishing the work. This is the most needful thing now.

"Everywhere, interest in the question of cremation is awakening, and the present points to a future—a near future—in which every city, large or small, upon the American continent, will consider the crematory a necessary part of its municipal outfit; and not only is it given to each one of us to look forward to a time when our cities will be redeemed from the curse of accumulating waste, when the rivers will be unpolluted by the sewage which now converts them into common sewers, when the cess-vault and the garbage-pit and the manure-heap, and even the earth cemetery, will be abandoned, when the age of filth-formation will be superseded by the era of filth-destruction, when fire will purify alike the refuse of the living, and the remains of the dead—but it is allotted to each one of us to help to bring in the coming of this sanitary consummation."

REMARKS ON DISPOSAL OF GARBAGE AND HOUSEHOLD REFUSE.[1]

By T. H. McKENZIE, C. E.,

Member Connecticut State Board of Health.

After giving this matter some thought, I must say that my conclusions are decidedly in favor of total incineration of all garbage and refuse.

The intense and sickening odors which are generated in the vicinity of the disposal works, the large areas of territory over which these odors are disseminated, the increased risk to life and health of employés in these works over those of ordinary cremating works, and the slight value of the products, have influenced me to this conclusion.

Many experiments that have been carried on for fifty years, more or less, with the idea of utilizing sewage and household wastes in fertilizing the soil, but after the most extended and careful investigations it has been decided by sanitary engineers that sewage has but little value as a fertilizer, and that all sewage disposal systems should be so planned as to get rid of the sewage in such manner as will be least offensive to the senses and where it will not breed disease, regardless of its value as a fertilizer.

The sand filtration process has, therefore, been adopted, where suitable land is available, and chemical purification, with destruction of the sludge by fire in localities where land is not available, as the best and surest solution of the problem, the health and comfort of the people taking precedence of all other claims.

I believe that we shall eventually reach the same conclusion on the garbage question, viz. : That the returns in the way of fertilizers are of but little value and should not be considered. I believe that cremation of swill, rags, sweepings, and household garbage, is the only safe and effectual method of disposal—that if any culling of iron, tin, glass, or other incombustible articles were permitted, it should be after it had been purified by fire. To allow of such culling in its crude state is to invite disease among a class of people already too dangerous and difficult to watch.

Dumping at sea, at places very remote from harbors and estuaries, is permissable in some instances, but this method is more costly than by fire, and at times is subject to serious interruption on account of storms. The method which is practised at Springfield, Mass., of spreading the garbage on sandy land near to the city and plowing it under daily, is equally as good in a sanitary point of view as burning, but there are but few large cities where the conditions are favorable for practising this method.

Cremating furnaces can be so constructed as to consume the gases which are generated from burning garbage, so that the odors will not be

[1] Presented at the Montreal meeting.

offensive and the garbage furnishing nearly enough fuel, aside from kindling, to consume itself. The ashes resulting from the combustion is odorless, and inoffensive, and can be sold as a fertilizer or used for filling low land.

According to statistics gathered by Mr. Boulnois, the city engineer of Liverpool, the cost of burning ranged from twelve cents to fifty-four cents per ton, and in a destructor recently erected by him for the city of Liverpool, the cost is thirty cents per ton, each furnace costing about $4,000, and having a capacity of from eight to ten tons daily.

The cost here given is an insignificant amount for its entire incineration, when we consider the extent of the nuisance produced by the attempts to extract the grease, tin, lead, and other articles of small value.

In cities where I am familiar with the methods, the city is at the entire expense of collecting the garbage and carting to some central point, where it is delivered free of charge to contractors. Here it is stored in bins for a time, usually, long enough for putrefaction to set in and breed pestilential odors; here men are employed to cull it over and select such articles as may have some commercial value, and the remainder is loaded into retorts and a limited amount of low-grade oil is extracted, and the dried residue converted into a cheap fertilizer.

The cities derive no benefit from this process, and for the sake of allowing a contractor to make a paltry profit on the grease and fertilizers extracted, the residents within a half or three-quarter mile of the furnaces must endure sickening odors from the putrefying garbage, and the poor laborers who work over it jeopardize their life and health.

On Nov. 16, last, I visited the Providence, R. I., works. These are located on a vacant tract of land very near the heart of the city known as the "Cove Lands." The price paid the contractor for collection of garbage is 15½ cents per capita per year, on a population of 140,000, making a total cost of collection in round numbers of $22,000. From the total collections of about 32 tons daily, there remains after extracting the oil, about eight tons of very inferior fertilizer, which is sold to the dealers in commercial fertilizers and by them used for adulterating guano. I shall never forget the sickening odors which emanated from the "Providence Swill Works," as they are called, and if 30 cents or even 40 cents per ton would pay the cost of burning, it would be much preferable to the present method.

If four furnaces were located in the outskirts of the several sections of the city, and the crude garbage burned, a large saving could be made in the cost of transportation, as well as the annoyance to the citizens by carting the garbage long distances through the prominent streets. The collection could be more expeditiously accomplished, and the material destroyed before putrefaction set in.

I noticed recently in one of our New England cities, having a population of about 100,000, that their dumping ground for all kinds of refuse was located on a tract of low land which was covered with water at high

tide; here were fifty or more scavengers collecting from the rubbish, rags, paper, decayed vegetables, and other small articles, which should have been immediately destroyed and which, if burned in a properly constructed furnace, would have supplied the fuel for burning of swill and other less inflammable substances.

Eventually, the lands filled with this decaying vegetable and animal matter, are built over, and the innocent tenants of the property wonder for what cause sickness and death enter their families, not knowing of the mine of decaying filth underneath their dwellings.

It is not necessary or advisable that ashes should be collected or disposed of at public expense, as in a sanitary point of view its presence is not objectionable, and it should be cared for at the expense of the tenant or owner of property.

All other refuse and wastes, commonly termed household garbage, such as cans, bottles, street sweepings, dead animals, and stable manure, should be at once cremated, so that whatever disposition is made of the residue, in a sanitary point of view, it will be harmless.

The subject of garbage disposal is one on which but little has been written, and of which there is but little popular knowledge, information concerning this subject being mainly confined to specialists who have invented some patented device for extracting oils or chemicals, and who are engaged in constructing works for some form of mechanical or chemical treatment by which to enrich themselves. Such specialists are not the safest guides in the selection of proper methods to be adopted, as in every instance that has come under my observation the production of commercial products has taken precedence to sanitary results.

This subject of garbage disposal is one on which the general public need to be educated and taught that the end to be sought is sanitary cleanliness, and that whatever method will quickly and completely destroy all such matter and be at the same time least offensive to surrounding inhabitants, is the method to be adopted.

Since making the above notes for discussion of the papers before you, I have learned of the construction of the Montreal Incinerating furnaces, built under the direction of Charles Thackery, C. E., and have paid them a hasty visit. I find here an ideal plant and entirely in accord with my idea of a model furnace, as expressed in my discussion.

The cost of the plant is stated to be $40,000, and has a capacity of 125 tons, or about 250 cubic yards per day of garbage. Mr. Thackery states that the cost of incineration by his process is guaranteed not to exceed 25 cents per ton.

In connection with these works, fumes and gases are passed over a live fire of coke at the foot of the chimney stack, and in every detail the plant has been constructed with the idea of immediate destruction, rather than utilization.

"The city of Montreal have apparently arrived at a successful solution of the garbage problem."

THE COLLECTION AND DISPOSAL OF THE REFUSE OF LARGE CITIES.[1]

By Col. W. F. MORSE,

New York City.

Since the beginning of the inquiries into the methods of garbage disposal by the committee appointed by the American Public Health Association in 1889, at its meeting in Milwaukee, there has been a development in the line of new inventions and methods pertaining to the subject which has hardly been equalled by the growth of sanitary ideas in any other direction.

Beginning with the building of cremating furnaces of crude and incomplete form, and methods of attempted utilization which were confessedly experimental and imperfect, there has resulted, after six years of patient, unremitting effort and the expenditure of large amounts of capital, systems or methods of garbage disposal which accomplish the purpose designed, and which indicate in an unmistakable way that this most vexatious and difficult problem is soon to be practically and thoroughly settled.

At the present time there are forty-three cities and towns of considerable size employing no less than fifteen forms or kinds of garbage cremating furnaces, and eight cities using two different methods of garbage utilization processes, while many others are experimenting with new types of furnaces, or allowing inventors to construct within their limits and with their sanction novel and complicated designs for extracting and obtaining valuable products from the waste.

Just now the great difficulty is to distinguish and disentangle those plans which experience and a record of continuously successful service have shown to have real value, from the vast variety of new and untried inventions, both in furnace construction and utilization processes, that are urgently thrust upon the attention of any one who manifests the slightest interest in the subject, each new idealist promising to outdo and distance every other competitor, and dispose of garbage at next to no cost to the city, and with an enormous prospective profit to the capitalist who may be credulous enough to support them financially.

But though the examination of all the multiplied plans, methods, schemes, and inventions is in the last degree wearisome and tedious, it appears to be the only way in which to secure the particular system or method that is best suited for each place. There is no uniformity of conditions in American communities except in very general way, hence each must examine and decide for itself, selecting that which appears to give the best sanitary protection with the least nuisance and annoyance and greatest economy of service.

[1] Read at the Montreal meeting of the Association.

So great is the interest taken in this question of improved waste disposal, and so large a measure of trouble has arisen from the present systems in use, that the largest cities of the country are now actively engaged in investigation and experiment.

The object of this paper is to present briefly a plan laid before the advisory board appointed by the mayor on the "Final Disposition of the Refuse of New York City," a body of gentlemen who are investigating all the known and proposed ways of garbage disposal throughout the world, with the view of recommending the adoption of that one which in their opinion will give best service for the city of New York.

The statements herein, it is believed, may be of service, as containing practical methods for the destruction of refuse containing garbage mixed with other waste, and the utilization of the products of combustion, both in obtaining power, and for making ground, which will apply equally well to other cities where the conditions and situations are similar.

THE DISPOSAL OF THE WASTE OF NEW YORK CITY.

The conditions under which the waste of New York city is collected and now disposed of present some features which are not found in any other city of this country. The situation of the city, bounded on three sides by deep water, affords an easy outlet to the sea for all waste by the cheapest of all conveyances,—water carriage. The narrow and long strip of land upon which the city is built offers access to the water front with short distances for hauling the waste. Hence, the obviously simple and natural methods for easy disposal was, and is, to dump all waste at the water's edge into large flat boats and tow these to sea discharging the loads beyond the shoal water of the bars and harbor mouth, and where the currents and tide would carry the floatable refuse off the land. The objections to this method are the storms and bad weather always experienced in winter, preventing the tows from going far enough from the land to dump, the consequent gradual filling up of channels and tide-ways by the accumulation of material which sinks when cast overboard, and the floating of that part of the waste which, when cast by the influence of the wind upon the shores, becomes offensive and obnoxious by decay and putrefaction.

To reduce the cost of sea carriage, and to create by the filling of vacant ground a site where future municipal buildings might be placed, the city began the deposit of waste at Ricker's Island, in Long Island Sound. After a few months it was found that the accumulation of large amounts of household offal mixed with the ashes and street sweepings created a nuisance, that the odors from this mass of putrefying matter were insupportable even at the distance of a mile to the main land, and that the upper part of the city was seriously affected by the objectionable smells. Harbor dumpings were again resumed, and the offensive bulk of matters decaying on Ricker's Island was disinfected by "Electrozone," for obtaining which an expensive plant has been erected on the island.

The difficulties and serious sanitary objections in this mode of utilizing New York city waste as the foundations for future buildings, and the experience gained this summer in the way of accumulating within the city limits, near to several thickly settled districts, thousands of tons of matter that will putrefy, will probably preclude the city from entertaining this method of disposal for the future, unless the laws of sanitation are more strictly observed.

It is proposed to destroy the putrescible organic waste in New York city by cremation. It is proposed to do this within the city limits, at places where the collections of each district of the Street Cleaning Bureau are now received, and to do the work with economy, speed, and freedom from offence. It is then proposed to remove the products of this combustion for filling at Ricker's Island, or any other convenient place. In other words, the whole collection of garbage, refuse, ashes, and waste of all kinds is to be received, the valuable portions taken out, the offensive matter destroyed, and the residuum, after reduction to an innocuous condition, to be utilized for making ground.

At the outset it must be understood that cremation means destruction,—not a process of treatment by chemicals, or the application of heat or steam to "render" garbage and manufacture a valuable product therefrom.

New York city was officially reported in 1893 as having collected 1,706,632 loads of refuse. The sources from which these were received were as collected by the

Street Cleaning Bureau	1,089,409
Street sweepings	305,755
From public markets	10,368
From public parks, works, and docks	24,949
Steam ashes from manufacturers and cellars, dirt, builders' waste, etc.	276,151
	1,706,632

If from this total there be deducted the street sweepings, manufacturers' ashes, and refuse from parks and docks, a total of 606,855 loads, the remainder, about 1,100,000 loads, will represent the refuse containing the putrescible organic waste from households and markets, and this will have to be destroyed.

The relative proportions contained in New York city collected waste may be stated as follows:

Coal ashes about	59	per cent.
Street sweepings	24	"
Garbage (organic waste)	15	"
Ice and snow (in winter)	2	"
	100	"

But when the street sweepings and manufacturers' waste is taken out and the remainder is considered as a whole for treatment by cremation, the proportion of garbage and combustible inorganic waste rises considerably and may be stated at 220,000 loads—while the ashes or incombus-

tible waste comprise 80 per cent., or about 880,000 loads. This is collected in fifty-eight different street-cleaning districts, from an area sixteen miles long by two miles wide, and brought to sixteen separate dumps scattered along a water front of twenty-eight miles.

The proportions of ashes and garbage in the waste collection becomes of great importance when the matter of separating them is considered. No separation is possible, unless this is made by the householder. When putrescible matter is once mixed with ashes the liquids are absorbed, the particles of vegetable and animal matter are coated with the fine ash, which no methods can afterward remove. It must be destroyed as it is. A separate collection of garbage, unmixed with refuse, sweepings, paper, cast-off clothing, broken crockery and glass, straw, hay, yard sweepings, and the vast body of worthless and discarded matter from the household, is a matter of very great difficulty and well-nigh impossible in a city like this. It might be done in those sections where individual householders live. The central part of the city, from Eighth street north, and between Third and Ninth avenues, might, by the enforcement of severe ordinances and the active co-operation of the police, be made in time to make a separation into two different garbage cans of the garbage and the ashes and other waste.

One thing is sure, it would double the number of unsightly and annoying garbage receptacles which now are too prominent objects along many streets, for if there is a daily collection, as there must be, at least in summer, there must be a daily separation of the waste and separate vessels, if this system is to be of any use. It would nearly double the service and work of the Street Cleaning Bureau. The garbage must be separately dealt with. There is no chance for the same cart to carry both garbage and ashes at once. To do the work speedily, nearly double the present number of teams are needed, and this, of course, greatly increases the present cost. In those sections of the city, outside the limits above named, the separation of putrescible or organic matter from inorganic is practically impossible, for reasons which are too obvious to need mentioning. The whole collection from this area would have to be destroyed by fire.

A very large percentage of the garbage actually produced in New York city is not dealt with by the Street Cleaning Bureau. From all the hotels and many restaurants the kitchen offal is taken away by persons who use it as food for animals in the adjacent territory. This is private property, not included in these estimates, not reported to the city, and not to be interfered with, except it conflict with sanitary regulations.

There is a considerable part of the waste which is of value. The city derives $90,000 per year from the sale of the privilege of sorting the waste and gathering valuable articles, afterwards sold. This item, which could be considerably increased by a thorough system of sorting and disinfection of the material, would go far toward defraying the cost of cremation.

The three principal points to be considered in cremating the waste of New York city are:

1. The receiving, handling, and separating the combustible from the great bulk of inorganic waste.

2. The destruction of the garbage and worthless refuse without offence and with speed and economy, and

3. The conveyance and deposit of the products of combustion and innocuous ashes to be used for filling purposes.

If it be desirable to destroy the garbage within the city limits the question of transportation to the place of cremation, and the location of furnaces, is of the first importance.

The present average haul to the dump is about three fourths of a mile. By consolidating the sixteen dumps to twelve, which can be done without great difficulty and small increase of cost for hauling, the number of loads is approximately equalized at each respective point.

Taking the largest number of loads (700) which has yet been received daily at any one point, as the quantity to be dealt with, we find that 250 loads of street sweepings, manufacturers' ashes, etc., would be deposited at once in the scows, and that 450 loads of 42 cubic feet each—about 700 cubic yards—would be left for disposal by cremation.

The main dumping board for ashes and garbage is seventy-five feet long, accommodating seven carts at once. Allowing five minutes for each cart to turn, back up, and dump, eighty-four loads can be discharged each hour in this space. The contents of the carts fall upon a separating platform, which will hold 160 cart loads at once, if needed. While the contents of the carts are being received the material is sorted, and the valuable articles taken out. It is believed that this sorting can be best done here, and the material easily handled and shifted on to the next platform, with no more labor than would be needed to trim the garbage in the scows. The width of this sorting platform can be regulated to suit the convenience of handling and shifting the refuse. It is covered with a pent house protected from the weather, and allowing no escape of light ashes or dust.

The shifting and sorting of the material goes on during the dumping, and the handling of the mass precipitates the ashes and fine particles to the bottom, where a part passes through screens or grids which form the floor of the separating platform.

The spaces for escape of fine ashes are narrow. Only the fine ashes, dirt, and dust can go through. This screen or grid may be set at an angle, or a series of sieves of screens driven by power can be used to make a more complete separation. Practical experience elsewhere has shown that this fine dust of ashes, sand, small particles of dirt, forming, perhaps, ten per cent. of the whole, are all that need to be taken out. The meshes are too small to pass the garbage, and whatever falls through is taken by conveyors running under the chute directly into the scow. In the summer collection there will probably be none, or a very

small amount of siftings, as the amount of garbage and refuse forms nearly two thirds of the cart load and would all be burned, but in winter the ashes are far more, and some would need to be taken out by these screens. The material having been passed by the sorters to the next platform, holding 240 loads at once if desired, is then taken by barrows running on narrow tracks outside and between the furnace and shot into the furnaces through the feed hole. The capacity of these furnaces is equal to the daily destruction of at least 500 loads of mixed garbage, ashes, and combustible refuse.

The fuel is petroleum oil drawn from storage tanks, which are covered by brick arches protected from any possible chance of fire. This fuel has proved to be the most efficient agent for consuming waste that has been tried. A six-months continuous run was made with two furnaces at the World's Exposition, Chicago, with oil as fuel, destroying daily 38 tons of garbage and sewage sludge, with absolute freedom from offence of any sort, and with no signs of combustion from the chimney. A portion of the heat produced in the furnaces is passed through a steam boiler generating power for making combustion, for moving the conveyors and screens, and, if needed, for electrical lights.

The ashes from the furnaces are taken out of the doors, and after dampening, are conveyed at once into scows alongside. When kitchen offal is unmixed with other matters, the ashes of this combustion are worth, for fertilizing purposes, nearly as much as wood ashes. Repeated analyses show the proportions of phosphoric acid and potash to be sufficient to form a reliable and valuable manure, but when the garbage is mixed with ashes, dirt, sand, and the like, the product is valueless for most uses except filling. It is used for roads in sandy soils, for foundation of walks and purposes of this sort, for which it is admirable. It may be ground to powder and made into mortar for rough work, or concrete foundations for pipes. There are many other uses to which this can be applied.

The proportion of ashes to be received from the combustion of 450 loads of mixed garbage, refuse, and ashes, is an unknown quantity. Probably it would be found that nearly one-half of the original amount would have to be removed from the furnaces. In the winter season this would rise to 60 or 70 per cent., and in summer fall to 25 or 30 per cent. About 40 per cent. may be taken as the average remaining after the reduction by fire.

The combustion of the most offensive city waste can be perfectly well done without nuisance of smoke, odor, fumes, or the discharge of ashes or dust from the stack, provided the proper construction of the furnace is made, the fuel completely consumed, the carbon destroyed, and the gases resolved into carbonic acid gas. With a chimney but 50 feet high, daily combustion of large amounts of sewage, garbage, animals, and miscellaneous waste, has been by this system so completely done, that none of the products of combustion were visible, nor were escaping fumes or odors noticeable. Perhaps the nearest parallel to the results of garbage destruc-

tion by this improved and perfected apparatus, would be the burning of an equivalent quantity of anthracite coal under the same conditions. No more offensive effects would attend the one than the other.

THE DISPOSAL OF THE WASTE OUTSIDE THE CITY.

There are several important reasons why the disposal of the organic waste of New York, as a whole, at a point removed from the thickly settled portion of the city, should receive serious consideration.

The expense for ground to be occupied by the twelve cremating plants, or of preparing wharves to carry the weight of the furnaces, if these piers are carried out from the land, the increased cost of transportation if a consolidation of the receiving points be made, the undoubted saving in construction by bringing the cremating plant into a compact and limited space, the fact that the work of destruction of an immense bulk of combustible matter would be less liable to interruption and delay in operation, and without danger to surrounding property or the possible chances of trouble and annoyance from unskillful or inattentive management of the furnaces—all these would suggest that all the waste be carried outside the city, and treated and destroyed as a whole.

If Ricker's Island be taken for this purpose, as was recommended by the advisory commission appointed by Mayor Grant, the whole collection, upward of 1,750,000 loads per year, would be brought to this point by the city scows. The expense of transportation would be lessened because of the release of dumping scows, which cannot enter behind the bulkheads to discharge their loads, and the employment of deck scows in their place saves an amount estimated at $50,000 per year.

The garbage and waste would be transferred by machinery, conveyors, and steam scoops, to the sorting and separating platforms, and from these that part which is to be destroyed would be burned. About one-half as many cremating furnaces would be needed at the island as would be required in the city, and their location in one or two central plants would allow of construction at far less cost.

The destruction of the garbage at any point outside the city does not call for alteration or change in the present contracts, or plans, of the street cleaning bureau, nor does it increase the expense of collection or delivery to the scows for transportation.

The value of the waste of New York city for making ground is a question which enters into any method of waste disposal.

An extract from the report upon this subject, made in October, 1892, by the special committee, Comptroller Myers and President Barker, of the tax department, may be quoted as giving the results of the investigation then made:

"Apart from all economic considerations, the necessity of keeping the waters of New York bay unpolluted by highly objectionable material would, in our opinion, alone be sufficient to condemn the present system as primitive and unworthy of the administration of a great metropolis.

. . . We believe that it is as much the duty of the commissioner of street cleaning to make a satisfactory final disposition of this material as it is to provide for its collection and removal from the streets. The cremation of garbage may be, and we believe will be, an accomplished fact in the near future. . . . In 1884 the city of New York bought Ricker's Island, consisting of 87½ acres, for $180,000, and in 1885, by act of the legislature, the state of New York granted to the city of New York land under water surrounding that island, and included in a twelve-foot contour line, with the right to crib in, fill up, and make additional dry land to the extent of 394 acres more. The average distance of towage involved in the matter of transportation to Ricker's Island is less than one half of that involved in the system now in force. Ricker's Island is a point accessible on each tide. Complaints of severe weather and the straying of boats and sinking of tugs at sea while conveying material to the dumping ground would not be heard, and the necessity of piling up and accumulating this material, with the resulting extra expense of re-handling so frequently occasioned by bad weather, would be entirely obviated. It is estimated that the saving which would be effected by the adoption of Ricker's Island as a place of final disposition would amount to nearly $180,000 per annum, or $613,711.90 during the period for filling in these lands under water."

There is no interruption because of bad weather in the disposal of garbage by cremation. When last year the dumping service was suspended ten days, and the accumulations of garbage became troublesome, there could be no relief except by resumption of the towing service. Such a state of affairs could not occur by cremation. No weather could stop the furnaces, and as the cremating plants are in duplicate, no ordinary stoppage for any reason can interfere with their work.

THE COST OF CREMATION.

Estimating the quantity of refuse annually collected at 1¾ million loads if the putrescible portions of this be destroyed by cremation at the twelve separate points within the city, and the ashes and inorganic waste remaining amounting to about 1,800,000 cubic yards be deposited at Ricker's Island, and, taking as the cost of cremation the amount now expended by the city for waste disposal $400,000, there would be an annual saving of $68,000 in favor of cremation as against towing to sea. If the garbage be destroyed by fire at Ricker's Island and the residuum used for filling, the annual saving is $55,000 as against sea dumping.

As compared with the treatment by process methods at the lowest price per ton which is paid by any large city in this country, and adding to this the probable cost of separating the garbage which would have to be done by the city, the annual saving in favor of the cremation methods is $150,000 per year.

The experience attained by nearly twenty years' use of garbage-destroy-

ing furnaces at forty cities in Great Britain, and by forty-three different places in the United States during seven years, has proved beyond any fear of contradiction that the incineration of worthless waste can be performed by furnaces constructed upon scientific principles and managed by skilful men, in a manner that shall afford complete immunity from nuisance, be able to do the work equally well upon a large scale as a limited one, be more economical than the extraction or reduction methods now in use, and destroy not merely a part, but all of the worthless matter which is produced by any community.

The difficulties to be surmounted in applying cremation for the disposal of New York city waste are, in the largest degree, mechanical and engineering problems. Given a cremating furnace burning fifty tons of garbage without nuisance and within a given cost, there can be no reason to suppose that the same methods applied in a larger furnace would not be able to destroy one hundred tons at the same or even less cost.

The apparatus for handling this larger quantity by labor-saving devices is at the command of every engineer. It is only a question of the use of machinery in the most efficient and economical way for receiving the waste and conveying away the products of combustion for utilization.

There is no doubt of the capacity of a garbage cremator for steam-making power, and if the problem of saving and employing this power has not as yet been fully worked out, the progress made in this direction will soon show sufficient saving to render the operation of cremation self-supporting.

The advocates of cremation do not believe in destroying material that is of value and service to mankind, provided its transformation into non-offensive and valuable products can be done as economically and with as little offence as it can be burned; but they do believe that in the present stage of experimental progress that cremation possesses advantages which no other methods have yet acquired.

REPORT OF THE COMMITTEE ON THE DISPOSAL OF GARBAGE AND REFUSE.[1]

As Chairman of the Committee on the Disposal of Garbage and Refuse, I respectfully desire to present the following report:

Much information is now in the hands of your committee, but it is not yet complete. Most of it pertains to experience gained in Europe, and data collected by myself while abroad. An insufficient amount of information is at hand regarding American practice and experience, and it is hoped that what is wanting will be supplied during the coming year.

Having but recently returned from Europe, it has been impossible for me as yet to properly collate, digest and finally put on paper the conclusions arrived at from the material gathered, and it is therefore the purpose of the committee, at the present time, to give merely an outline of the work done and of that which is still under consideration.

There are two kinds of city refuse: The liquids (including suspended matter) which are removed by properly constructed sewerage systems; and the solid refuse, namely, such as cannot be removed by water carriage, and consists of garbage, ashes, street sweepings, market and trade refuse, and general rubbish. The latter kind constitutes the subject matter with which your committee is instructed to deal.

Like the collection and disposal of sewage, the whole subject of the collection and disposal of solid refuse must be treated from both sanitary and economical standpoints. The work must be satisfactorily performed in both respects, otherwise a successful result cannot be obtained. There may be a disposal which is entirely proper in a sanitary way, yet its expense may be so great that the method precludes general adoption. On the other hand, some cheap methods of disposal may not comply with sanitary requirements, and also cannot be recommended.

The utilization of refuse is a secondary consideration to its proper sanitary disposition. If the cost of disposal can be reduced by utilizing a part or the whole of it, then such utilization should be advocated, but merely for financial reasons.

At the present time the question of a proper disposal of city refuse is not satisfactorily settled. Different views are held and different methods and appliances are advocated, both in Europe and America. In almost every country the subject is being studied, and trials of various processes are being made. England is furthest advanced. In Germany there have been several investigations and reports made; and trial furnaces are to be erected this winter in Berlin and Hamburg. The city of Brussels has had a furnace for two years, the first one operated on the continent for any large city. Paris has as yet only made studies, and has erected no works. All other cities of the continent are using ancient and crude

[1] Read at the Montreal meeting of the Association.

methods, and are waiting to see what the larger communities will accomplish with their experiments.

In America the question of garbage disposal is uppermost in many cities. The older methods are no longer endurable, and at the present time more new ones are being discussed and tried here than elsewhere. We have quite a variety of furnaces, also several extracting or reduction works, besides the older and cruder methods of disposal.

The subject is everywhere receiving so much attention, that the time is probably not far off when the ground will be cleared and satisfactory conclusions can be obtained regarding the best modes of refuse disposal.

It may not be out of place to call attention to the fact that, while the subject is of considerable importance to communities, yet it seems to be somewhat more to avoid a nuisance rather than to obviate serious dangers from a sanitary point of view. There are but few communities where crude methods are not still in use, and, when making inquiries regarding any effect upon the health of those residing in the neighborhood or of those engaged with the refuse, I have failed to discover anything which would indicate an unhealthful condition in those connected with its disposition.

In Berlin the garbage dumps are daily visited by persons who pick out matter of value to themselves or which can be sold; yet no sickness that could be traced to their occupation was reported to have arisen among such persons. In London a large number of women were engaged in picking over the refuse, and they looked hearty, and I was informed that no sickness among them was known to have been caused by their work, and as they are appointed by the city, vacancies are eagerly sought because the work brings fair wages for a fixed number of hours, and leisure thereafter. In America we are also aware of the fact that whole families are engaged in picking over the garbage piles of large cities.

This immunity from disease and the fact that no great evils have resulted from the crude methods, are probably the reasons why proper disposal methods have only recently been urged, even in the larger cities. In our endeavor to cleanse the city, this subject has at last received the attention which is its due in every modern civilized community.

The subject under consideration by the committee is to be divided and discussed under the following heads:

1. *Character of City Refuse.*
2. *Collection and Removal to the Place of Disposal.*
3. *Final Disposition.*

I. CHARACTER OF CITY REFUSE.

There is a great diversity in the character of the refuse in Europe and America, and even between that of the different cities of the same country. This diversity explains why one method of disposal has sometimes been found satisfactory in one locality and not in another.

There is a difference in the degree of moisture. We find, for instance, in some of the European cities, that waste is comparatively so dry that the conveyances for its removal are constructed so as to prevent dust from escaping therefrom. Whereas in some other cities the refuse as collected contains as much as eighty per cent. of water, so that the vehicles must be constructed to retain water.

The amount of unburnt coal contained in the garbage, likewise varies considerably. While in Berlin the refuse indicated almost no unburnt coal, I found in England a large amount of it, particularly from some districts of cities, where the prevention of extravagance in the use of coal does not seem to be an object. Some cities, again, have a large amount of wood, paper and packing material, as, for instance, in the city of London and in the business sections of New York; while in other cities, or parts of cities, very little of such waste material is found.

In the dwelling house and hotel refuse there is likewise a difference in different countries. The quantity observed in some American cities, is much greater in comparison than in some European cities. The street sweepings also show a great difference in character. On well paved streets there is much more organic refuse, consisting principally of manure, than on streets which are badly paved, and where a great deal of mud is mixed with the manure.

It must be evident from these facts, that different methods of treatment will be required in different cities, and each method must be especially chosen with regard to the character of the refuse to be disposed of.

In some cities it is found that all kinds of refuse are mixed and collected together; in others, certain portions are separated and disposed of independently. This has seemed to be advantageous on account of the methods used for disposal.

The committee will endeavor to obtain as far as practicable, the analysis and composition of the garbage in different cities where certain methods of disposal have been in use, so as to have more tangible figures regarding the difference of character, and be able, in a measure, to judge of the applicability or of the success of certain methods under certain conditions.

II. COLLECTION AND REMOVAL TO THE PLACE OF DISPOSAL.

The difference in the character of refuse obviously necessitates different kinds of utensils for collection and carts for removal. It is the purpose of your committee to describe and illustrate such pails, barrels, etc., as have given satisfaction in various climates and for their several purposes; and also all carts and wagons used to convey the refuse from the buildings to the place of disposal, under different conditions. Dumping scows and boats to carry the refuse out to sea will also be described.

III. FINAL DISPOSITION.

The most important part of the subject and one which requires most time and study, if satisfactory conclusions are to be reached, is the final

economical disposition of the city's refuse, so that it will not subsequently be a nusiance.

The Woolf process for treating the garbage, as lately practised for New York city, is simply a disinfection, and can only be considered as a temporary expedient. This process and similar ones, contemplating merely a disinfection, cannot therefore be classed under the above head.

There are five different methods of refuse disposal in use. They may be briefly described as follows:

1. *Dumping on land.*

This expedient is very extensively adopted and, for small communities, and under proper conditions, it has been considered satisfactory. But the organic refuse is not properly destroyed, and remains indefinitely in a decomposing condition. In large or in rapidly growing cities it must be objectionable, because of the danger of using such territory at a later time for building purposes. There have been cases recorded where sickness was traced to the fact that buildings had been erected upon such ground, and where the exhalations ascended from the cellar and through the building, a natural effect of certain conditions of temperature and of improperly constructed houses not infrequently found in our cities. A case recently came to my notice, which indicated that garbage can remain in a decomposing condition for hundreds of years, as evidenced by some excavations in the city of Rome.

2. *Dumping into the ocean or a large river.*

Wherever the city refuse can be conveyed to points in the ocean from which it will not return to the shores, there is no reason why this method should not be entirely sanitary, because the refuse is all removed and the organic part of it is probably consumed by fish and other aquatic life. We may say the same of any large river in which the depth is not affected by such dumping.

3. *Fresh garbage can be used as food for stock on farms.*

Such a disposition can readily be made in small cities, and the most objectionable part of the refuse thus removed. In large cities, however, the quantity is too great, and the expense of its removal is also too great to be satisfactory. It is is also found that the character of such garbage is often unfit for consumption on farms. Hotels and large establishments may derive some revenue by selling it for farms, and in their case this may prove to be a satisfactory solution of the question. But its adoption for an entire city cannot give good results, and experience has shown this to be be case.

4. *Garbage if separated from ashes, wood and similar material, and subject to rapid decomposition, can be disposed of by a reduction process, in which the fatty matter is extracted and the remainder converted into a fertilizer.*

Such processes are not used in Europe, but have been employed in several cities of America. The best known are the Merz and the Simonin systems. The garbage is first heated and dried by superheated steam at temperatures of about 300 degrees F. In six hours more or less, the garbage loses over one half of its weight, and is sufficiently dry for the next operation which is the addition of benzine or a similar liquid, by which the oily constituents are removed. The benzine is then separated from the fat and recovered to be used over again.

Such works require the original separation of the city refuse, because the above process can be applied only to comparatively fresh vegetable and animal refuse.

Nuisances have been complained of in a number of cities where these methods have been adopted. But they are incidental, and not necessarily due to the process itself. Visits to the works at St. Louis, Mo., and Providence, R. I., indicated that these nuisances were due to bad ventilation and an insufficient force engaged to maintain cleanliness.

My personal opinion is that the reduction system can be operated without causing a nuisance, but that the question of its superiority in each case must be decided on economical grounds.

The report of the committee will give details of works, reports of local authorities and items of cost, so far as available.

5. *Cremation of refuse.*

This method of destruction is to-day used more extensively and has also been used for a longer time than the preceding one. In England we have experience ranging over twenty-five years. The first example of a furnace, the main features of which have been successful up to the present day, is to be found in Manchester, where in 1878 Mr. Fryer erected a furnace, with which his name is connected. Such a furnace, built in Southampton, England, was illustrated in the previous report of your committee, and also briefly described. Furnaces of this pattern have been built in a number of cities, and have been followed by numerous others, with more or less important improvements.

The best of the English furnaces with which ample experience has been had, are the following:

a. Manlove, Alliott & Co. have continued to build, substantially, what may be termed the original Fryer furnace.

b. The Horsfall furnace, which introduces steam and air under the fire bars to lengthen their life and to increase the heat.

c. The Warner furnace, containing improvements in the method of feeding and of drying the refuse before it descends upon the grate bars, and also in preventing cold air from impinging upon the burning garbage when feeding.

Full descriptions, with illustrations of these furnaces, will be given, with reports concerning their efficiency and the cost of operation.

In Germany the question has been under investigation, with the result

that Horsfall and Warner furnaces have been recommended, and are now being built on a large scale in Berlin and Hamburg, in the former city at present merely for experimental purposes.

The Brussels furnace, patented by Smeyers, is also substantially like Fryer's furnace, but has improvements for giving the garbage a better preliminary drying. It differs also in other respects, has been in operation since 1892, and is reported as being entirely successful. The committee has plans and descriptions of the same, and hopes to obtain also some items of cost.

In America the cremation of garbage has hardly as yet been as successful as it is in Europe. While in the latter country fuel is seldom added, such addition has, so far, generally been necessary with the furnaces in use in this country. European garbage is, as a rule, dryer, but it does not contain quite as much combustible matter as ours.

The furnaces most generally used in America are the Engle and Rider. The former was used to dispose of the garbage of the World's Fair, Chicago. Recently other furnaces have been recommended, notably, the Anderson in Chicago, and Thackeray's furnace in Montreal.

The committee hopes that, during the next year, the collected material will be placed in proper shape before the association, so that the processes may be compared as to efficiency and cost, and it also expects to draw such inferences and conclusions as may seem warranted from the results. At the present time it can only state: That there are several ways of disposal, which have been and can be made satisfactory from sanitary points of view; that cremation of garbage is at present in the lead, so far as the number of applications and the character of results are concerned; but that it has not everywhere been entirely satisfactory in both economical and sanitary respects.

RUDOLPH HERING,
Chairman.
L. LABERGE,
Medical Health Officer of Montreal.
DELOS FALL,
Member Michigan State Board of Health.
EDWARD CLARK,
Ex-Health Officer, Buffalo, N. Y.

DISCUSSION.

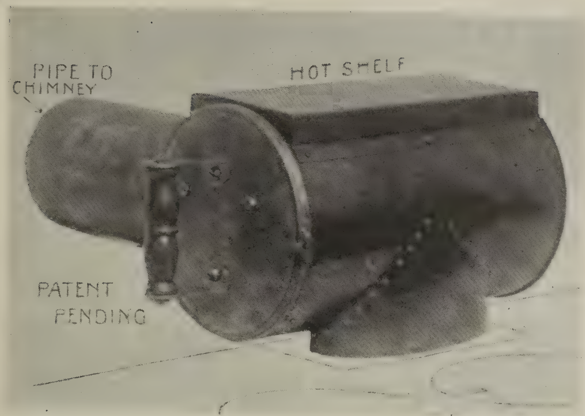
DR. S. H. DURGIN, of Boston.—I want to show to the Association photographs of a recently invented kitchen garbage dryer, and will occupy but a few minutes in explaining its use. It is well known to the Association that I have entertained the belief for some years that all kitchen garbage should be disposed of in the kitchen before it becomes a nuisance, and thus avoid the disgusting odors and expense which attend the present methods of handling. It consists of a perforated

sheet-iron basket, with a tight bottom and a capacity of three or four quarts. It is inserted into an expanded section of the stove pipe, a short distance above the stove, and allows the hot air and smoke to pass on all sides of the basket. It is easily withdrawn from its position and replaced with one hand. It will receive the garbage as it occurs several times a day, and needs to be emptied but once in twenty-four hours. The garbage dries to a charcoal without burning, and becomes an excellent fuel for kindling the fire in the morning. It does not compromise the use of the stove, interfere with the draft, require more fuel, or cause any odors.

While considering its sanitary advantages, we should not forget the financial side of this question, for it is costing most cities more money to perpetuate the kitchen garbage nuisance by present methods of storage and removal than for the maintenance of their entire health departments. In my city of 500,000 inhabitants it cost the city last year for collecting and hauling away the kitchen garbage alone $182,000, and this sum must be increased yearly, without taking into account the additional cost of a public cremator or reducer. I have nothing to say against the large public crematory for the general rubbish and wastes of the city, which always contain more or less garbage; I believe that this general mixture, excluding kitchen garbage, can and should be burned and its ashes put to the uses of clean gravel. I will pass these photographs around, and say that they represent one which I have had in use in my house for the last two months, and which absolutely disposes of the nuisance and expense of handling kitchen garbage.

A Member.—How much does the apparatus cost?

Dr. Durgin.—The one in use in my house, the only one yet constructed, was invented and made by Messrs. Taylor & McLaughlin, at 120 Fulton street, Boston, and was the result of a short talk with them about two months ago. I am told that the cost will be about three to five dollars.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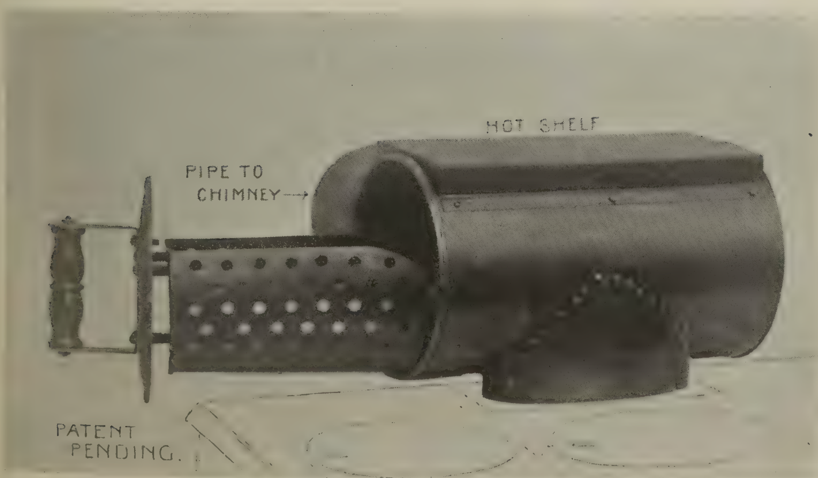
HOT SHELF
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PREVENTION OF THE SPREAD OF YELLOW FEVER.[1]

BY WALTER WYMAN, A. M., M. D.,

SUPERRVISING SURGEON GENERAL, U. S. MARINE HOSPITAL SERVICE.

MR. PRESIDENT, AND GENTLEMEN :—One of the prime factors in the prevention of the spread of yellow fever is an early knowledge of its existence. A study of the history of nearly all epidemics, will show that the disease has gained considerable head-way before its existence has been admitted or publicly announced. The reasons for this are obvious : oftentimes there is a genuine doubt in the mind of the practitioner, and the ability to accurately and positively diagnose yellow fever is not possessed by every physician. When in serious doubt, the fear of raising alarm, with all the consequent damage to the commerce of the city or town, induces the practitioner to hold his peace ; or he may absolutely conceal the cases, when known, in the hopes that they may prove sporadic.

For example, during the examinations which were made of the mortuary records of Brunswick, Georgia, in connection with the yellow-fever epidemic there in 1893, it was demonstrated by a process of reasoning to be explained further on, that yellow fever had prevailed in Brunswick in 1890, and had been kept concealed. Not only did the mortuary records show this, though the cases were not diagnosed as yellow fever, but evidence of creditable citizens has been obtained to this effect ; and reliable testimony, that one of the physicians of Brunswick had made the statement in the fall of 1890, that yellow fever was prevalent—almost epidemic—and "if the Lord did not send a frost soon, it would be impossible for them longer to conceal it." It is known now that yellow fever had existed last year a month prior to the death of Assistant-Surgeon Branham and prior to its being declared epidemic.

It is evidently, therefore, of the highest importance, that, when suspicious cases are announced, they should be passed upon by some well known expert, whose decision will be accepted as final ; and who is free from all local influence. Acting upon this theory, the Marine Hospital Service does not hesitate to send immediately an expert to any locality suspected of being infected with yellow fever. One who can proclaim the disease if it exists, without bringing upon himself the anathemas of friends, associates, and city authorities, and the ruin of his professional prospects.

A new method of determining the presence of yellow fever, in some cases with positive accuracy, has been announced by Dr. John Guiteras, professor of pathology in the University of Pennsylvania, and at present sanitary inspector of the Marine Hospital Service. I can best explain his theory by reading his letter to me upon the subject :

[1] Presented at the Montreal meeting of the Association.

PHILADELPHIA, PA., SEPTEMBER 18, 1894.

Dr. Walter Wyman,
Surgeon-General,
U. S. Marine Hospital Service:

SIR:—According to promise I give you in brief, the practical application of the studies I have made of the death rate, in relation to yellow fever.

I have frequently found peculiar features of the mortality immediately preceding the acknowledgment of the presence of an epidemic of yellow fever. When these features are sufficiently pronounced, they enable a careful student,

1. To announce, without fear of contradiction, the existence of a commencing epidemic of yellow fever, when, perhaps, it is denied on the ground of carelessly observed clinical data;

2. To point out the existence and the date of beginning and ending, of outbreaks in past years, which outbreaks had not been generally, if at all, recognized;

3. The student is further enabled to allay excitement, and silence false and damaging rumors as to the existence of yellow fever in a locality. He may even foretell, with some degree of certainty, that an epidemic of yellow fever is not likely to arise within the city and season, subject to his observation.

These accomplishments, theoretically, all amount to the same thing, namely: the finding of yellow fever through other than bedside observations; but I thus separate them, because, practically, they deal with queries that present themselves to the so-called yellow-fever expert, as distinct problems of great importance.

The peculiar features of the mortality, upon which the solution of the above problem is based, are an unusual preponderance of deaths, in the white population in general, and especially of white children, and natives of the northern section of the country and Europe. The causes of death that are found to account for this increase of the white mortality are: acute cerebral and gastroenteric affections, of children, and above all, acute manifestations of malaria.

This means, in my opinion, that errors of diagnosis are made in the early stages of the epidemic, and that, frequently, the case which is supposed to be the starting point of an outbreak, is not the first case of yellow fever occurring in that particular epidemic. Isolated cases have developed in the earlier portion of the summer, and, I believe, not rarely, are the result of importation that has taken place towards the end of the preceding season, or during the winter or spring.

The errors of diagnosis between the yellow and the malarial fevers, will be the subject of a special report. Much of what was written along our Atlantic border concerning the malarial fevers, in the earlier days of the American School of Medicine, shows the frequency of these errors. The bilious remittent fever was frequently yellow fever. The former disease gradually disappeared, with the retreat of yellow fever towards its tropical home.

Yours very truly,

(Signed) JOHN GUITERAS.

Acting upon the theory advanced in this letter and with a strong determination to promply prevent the spread of yellow fever during the present season, as early as July of the present year, Dr. Guiteras was ordered to visit the various coast cities of the south from Baltimore to Mobile, and to examine the mortuary records thereof and to promptly report to the Marine Hospital Bureau any suspicion of yellow fever in any of the cities resulting from said investigation. He has just concluded his examination of the mortuary records of the cities of Baltimore, Norfolk, Wilmington, Charleston, Savannah, Jacksonville, Key West, Tampa, and Mobile. In none of these records has he found any suspicion of the existence of yellow fever at this season.

A blank form has been provided to be filled out at stated intervals by the Marine Hospital officers stationed in these various cities, which will in future give the bureau the desired information and call attention to any possible danger as shown by said records.

Experience proves that when the existence of yellow fever is suspected reliance can not be placed upon the reports of physicians, and a house to house inspection, therefore, should be made, under municipal or state authority.

A knowledge of the existence of the disease having been obtained, the first efforts should be made to confine it to its present locality. Much has been written of the futility of attempting to stamp out yellow-fever. In view of the fact, however, that most epidemics have become well established before being announced and before any steps have been taken to suppress them, the futility of these efforts should not deter us from attempting to check the disease after the presence of a limited number of cases. If, for example, a few cases have been found, and examination of the records shows that in all probability the disease had not previously existed before these cases were discovered, there would be reasonable ground for hope of preventing its further spread by active local quarantine measures. These may be stated briefly as follows, viz.: An early house to house inspection; the depopulation of the house or infected area, care being taken to disinfect the clothing of exposed persons, the non-immunes leaving the infected area to be kept under observation, and if possible in a place set aside for this special purpose; house or district quarantine; a thorough disinfection by sulphur fumes and bi-chloride of mercury of the infected places and their contents. At this time the facts as they exist should be made public, with a view of allowing those who wish to leave the city to do so. Depopulation of the city at the very first appearance of yellow fever, which in all probability will become epidemic, is greatly to be desired, but under restrictions hereinafter mentioned.

As soon as the disease has become epidemic, consideration for the surrounding country takes precedence over the comfort and commercial interests of those within the infected area; a strong cordon by land and by sea is to be drawn, military in character, and egress from the city thereafter allowed only through a detention camp where those leaving the city must be forced to undergo a period of probation of ten days to demonstrate their freedom from the disease.

Following are the regulations which were promulgated by the secretary of the treasury, August 12, under the act of February 15, 1893, to prevent the spread of yellow fever:

United States Quarantine Rules to be Observed in Places Infected with Yellow Fever.

Treasury Department,
Office of the Secretary,
Washington, D. C., August 12, 1893.

To medical officers of the Marine-Hospital Service, quarantine officers in the United States, and others concerned:

Pursuant to the act of February 15, 1893, entitled "An Act granting additional quarantine powers and imposing additional duties upon the Marine-Hospital Service," the following regulations have been made thereunder and are hereby promulgated according to the terms of the act:

1. All persons affected with yellow fever, or who are believed to have been exposed to the infection, will be isolated under observation until free from infection and all their effects properly disinfected. Communication with infected places will not be allowed except for the necessary conveyance of supplies, etc., which must be under the supervision of a duly qualified medical sanitary inspector.

2. The localities contiguous to those infected, and infected localities, so far as it may be safely done, should be depopulated as rapidly and as completely as possible; persons from non-infected localities, and who have not been exposed, leaving without detention; those who have been exposed, or who come from infected localities, being required to undergo a period of detention of ten days from date of last exposure in camps of probation. The clothing or anything capable of conveying infection shall not be allowed to leave the infected locality without disinfection.

3. Camps of probation shall be inspected twice daily or oftener, and the suspects should be conveniently segregated in groups. A hospital sufficiently isolated shall be provided for each probation camp.

4. When practicable, camps of detention should be provided for those who require it.

5. Buildings in which cases of yellow fever have occurred, and localities believed to be infected, must be disinfected as thoroughly as possible.

6. As soon as the disease shall have been declared epidemic, the railway trains carrying persons who may be allowed to depart from a city or place infected with yellow fever shall be under medical supervision. A medical sanitary inspector should accompany each train when practicable, and enforce prompt isolation of any person who may be attacked with the disease, and report the same immediately to the proper health authorities. When, in the opinion of the proper health authorities, it is necessary, the railroad companies should be required to attach an extra car for hospital purposes to each train carrying persons from an infected place, which may be side-tracked at some safe and convenient locality on the road.

CHARLES S. HAMLIN,
Acting Secretary.

It will be opportune here to read from the more recent regulations which have been prepared in the Marine Hospital Bureau and promulgated by the secretary of the treasury to prevent the spread of certain diseases, viz.: cholera, yellow fever, small-pox, typhus fever, leprosy, and plague. The portions of these regulations applying to yellow fever are given here in detail.

ARTICLE II.

NOTIFICATION.

1. State and municipal health officers should immediately notify the supervising surgeon-general of the United States Marine Hospital Service by telegraph or by letter of the existence of any of the above mentioned quarantinable diseases in their respective states or localities.

ARTICLE III.

GENERAL REGULATIONS.

1. Persons suffering from a quarantinable disease shall be isolated until no longer capable or transmitting the disease to others. Persons exposed to the infection of a quarantinable disease shall be isolated, under observation, for such a period of time as may be necessary to demonstrate their freedom from the disease.

All articles pertaining to such persons, liable to convey infection, shall be disinfected as hereinafter provided.

2. The apartments occupied by persons suffering from quarantinable disease, and adjoining apartments when deemed infected, together with articles therein, shall be disinfected upon the termination of the disease.

3. Communications shall not be held with the above named persons and apartments, except under the direction of a duly qualified officer.

4. All cases of quarantinable disease, and all cases suspected of belonging to this class, shall be at once reported by the physician in attendance to the proper authorities.

5. No common carrier shall accept for transportation any person suffering with a quarantinable disease, nor any infected article of clothing, bedding, or personal property.

The body of any person who has died of a quarantinable disease shall not be transported save in hermetically sealed coffins, and by the order of the state or local health officer.

ARTICLE IV.

YELLOW FEVER.

In addition to the foregoing regulations contained in Article I, the following special provisions are made with regard to the prevention of the introduction and spread of yellow fever:

1. Localities infected with yellow fever, and localities contiguous thereto, should be depopulated as rapidly and as completely as possible, so far as the same can be safely done; persons from non-infected localities, and who have not been exposed to infection, being allowed to leave

without detention. Those who have been exposed, or who come from infected localities, shall be required to undergo a period of detention and observation of ten days from the date of last exposure in a camp of probation or other designated place.

Clothing and other articles capable of conveying infection, shall not be transported to non-infected localities without disinfection.

2. Persons who have been exposed may be permitted to proceed without detention to localities incapable of becoming infected, and whose authorities are willing to receive them, and after arrangements have been perfected to the satisfaction of the proper health officer for their detention in said localities for a period of ten days.

3. The suspects who are isolated under the provisions of Par. 1, Article III, shall be kept free from all possibility of infection.

4. So far as possible, the sick should be removed to a central location for treatment.

5. Buildings in which yellow fever has occurred, and localities believed to be infected with said disease, must be disinfected as thoroughly as possible.

6. As soon as the disease becomes epidemic, the railroad trains carrying persons allowed to depart from a city or place infected with yellow fever, shall be under medical supervision.

7. Common carriers from the infected districts, or believed to be carrying persons and effects capable of conveying infection, shall be subject to a sanitary inspection, and such persons and effects shall not be allowed to proceed, except as provided for by Par. 2.

8. At the close of an epidemic, the houses where sickness has occurred, and the contents of the same, and houses and contents that are presumably infected, shall be disinfected as hereinafter prescribed.

ARTICLE V.

DISINFECTION FOR YELLOW-FEVER.

1. Apartments infected by occupancy of patients sick with yellow fever, shall be disinfected by one or more of the following methods:

(*a*) By thorough washing with an acid solution of bichloride of mercury (bichloride of mercury 1 part, hydrochloric acid 2 parts, water 1,000 parts) or other efficient germicidal agent. If apprehension is felt as to the poisonous effects of the mercury, the surfaces may, after two hours, be washed with clear water.

(*b*) Thorough washing with a five per cent. solution of pure carbolic acid.

(*c*) By sulphur dioxide, 24 to 48 hours' exposure, the apartments to be rendered as air-tight as possible.

2. Bedding, wearing apparel, carpets, hangings, and draperies, infected with yellow fever, shall be disinfected by one of the following methods:

(*a*) By exposure to steam at a temperature of 100° to 102° C. for thirty minutes after such temperature is reached.

(*b*) By boiling for fifteen minutes, all articles to be completely submerged.

(*c*) By thorough saturation in a solution of bichloride of mercury, 1 to 1,000, the articles being allowed to dry before washing.

Articles injured by steam (rubber, leather, containers, etc.), to the disinfection of which steam is inapplicable, shall be disinfected by thoroughly wetting all surfaces with (*a*) a solution of bichloride of mercury, 1 to 800, or (*b*) a five per cent. solution of carbolic acid, the articles being allowed to dry in the open air prior to being washed with water, or (*c*) by exposure to sulphur fumigation in an apartment air-tight, or as nearly so as possible.

A new feature in the management of an epidemic of yellow-fever was demonstrated during the recent epidemic in Brunswick, viz., the stationing of a medical officer in command of the districts outside of the cordon lines and detention camp. The officer in command on the field of action must necessarily be at the centre to attend to the guards, to supervise the treatment of the sick, the disinfection of clothing and buildings, and other necessary measures of sanitation. His work may be well supplemented by an officer in command of measures to be taken outside, with the triple object of pursuing and returning any refugee who may have escaped the cordon lines; of investigating rumors which are always rife of the spread of the disease in other localities; and taking measures to prevent people from the infected or suspected districts travelling upon the railroads unless provided with a proper certificate, showing that there is no danger of their carrying infection with them.

I know of no easier way of fully describing the methods to be taken to prevent the spread of yellow-fever, than by giving a short narrative of the measures which were put into operation in and around Brunswick during the yellow-fever epidemic in 1893.

YELLOW FEVER ON SATILLA RIVER AND AT BRUNSWICK IN 1893.

June 15, 1893, the American Barkentine *Annita Berwind*, from Havana, arrived at Brunswick, Georgia, quarantine. She cleared June 19 for Conquest's wharf on the Satilla river, Georgia, fifty-six miles from Brunswick, arriving there on the 20th; on the evening of which day the master took to his bed. On June 21 he was moved to Conquest's camp, a cross-tie camp eight miles distant from the wharf, where he died, June 25, of yellow-fever. The vessel was immediately sent to the national quarantine station at Blackbeard Island, and twenty-five stevedores who had been loading her were also sent there for detention and observation. Surgeon H. R. Carter was immediately sent to Conquest's camp with authority to employ guards, nurses, and physicians, and, with the volun-

tary assistance of Dr. W. F. Brunner, took every possible precaution to prevent the spread of the disease, keeping the seventy-three persons in the camp under a close observation, burning and boiling all the possibly infected articles, and disinfecting the house wherein the patient died.

The following are extracts from his reports dated July 1 and 3:

July 1.

There are seventy-three persons in the camp, living in small houses scattered through the brush. The nurses and others directly exposed are isolated separately and all others are under surveillance, being inspected twice a day by myself. One man who was directly exposed to contagion ran away before I reached here, but I have, I believe, located him, and have sent the constable after him.

Dr. Brunner (to whose help I owe much) and I burnt and boiled nearly all of the possibly infected articles yesterday, and will finish to-day. I have sent to Brunswick for disinfectants, and I will disinfect the house, etc., when they arrive. The house is open, unoccupied, and under guard. There is considerable difficulty in managing the personnel of the camp, or rather, it is a matter of some delicacy, as they frankly said that had they known we were coming, they would have run off, and it is only by making it to their interest to stay here that I can hold them.

I authorized the issue of a ration to the families (eight in number) of the stevedores taken to Sapelo. They were absolutely destitute, and as it was necessary to keep them under surveillance, there was no other way. They were in full communication with the stevedores during the six days of loading. I engaged Dr. McKinnon to inspect them every day. I cannot do this, as they are scattered over a radius of about eight miles, and the nearest one is ten miles off from here. Any sickness among them will be reported to me.

Dr. Atkinson will help me here after to-day; he having also been exposed it seemed well to keep him under surveillance. The probability is that I shall be here about fourteen days if there are no new cases. I confess, however, that I regard it as not at all unlikely that we may have others. Other cases will not materially complicate matters if they occur among those whom I have in close isolation.

July 3.

No new cases of fever so far. Yesterday I brought back the suspect who had left camp the day before my arrival, as the constable failed to do so. He is now in camp. The disinfectants arrived yesterday, and to-day I am treating the house with sulphur dioxide. It is too open, in spite of calking, to do a very satisfactory disinfection by this means, but I have used the gas in excess threefold. Will use the bichloride solution to-morrow. All fabrics have been burnt or boiled as their condition required.

I have been hauling light wood and piling it all over the wood-pile and trash-heaps in the yard of the house, and I will burn it off this afternoon. I would have done this before, but it was too wet. The object is to burn off all vegetable matter down to the sand, which it will do. I have already burnt large fires over the places where the excreta were thrown, keeping them up eight or nine hours. Dr. Brunner left for Savannah yesterday at 4 A. M.

Owing to the thoroughness of the above measures, there was no development of the fever in the camp or at the wharf.

This captain of the *Annita Berwind*, who died at Conquest's Camp, was said to have been feeling ill before leaving Brunswick quarantine, and was known to have visited the city. This led to an inspection of the Brunswick quarantine by Surgeon Carter, by which it was shown that there was gross violation, not only of the United States quarantine regulations, but of ordinary quarantine principles.

Acting upon the information thus received, the National Government took charge of the Brunswick quarantine under the act of February 15th, 1893, and Assistant Surgeon J. W. Branham, Marine Hospital Service, was placed in command.

Dr. Branham took charge of the quarantine July 31st, and died August 20th. Under a misapprehension of the nature of his disease, he had been removed by the health officer of Brunswick from the quarantine to the city for treatment. From the reports of the medical officers subsequently assigned to duty in Brunswick it appears that there were a number of infected localities in Brunswick at about the same time and the evidence does not warrant the assumption that Dr. Branham introduced yellow fever into the city.

In Surgeon Murray's report, it is shown that he may possibly have contracted the disease from the ballast pile at the quarantine station, but at the same time the colored laborers engaged in discharging ballast at the quarantine (21 in all) had free access to the city, and it was through them and not through Dr. Branham, that the disease was probably introduced and generally disseminated. Dr. Branham was in the city on the 10th of August; in the afternoon returned to quarantine; on his way to the station was seized with a chill which was followed the next day by a fever; was removed on the 11th to the city and on the 12th was reported as suffering from yellow-fever.

Surgeon W. H. H. Hutton was immediately ordered from Norfolk to Brunswick, arriving there on the evening of August 14; and Surgeon H. R. Carter, who was at Pensacola, was also ordered there, arriving on the morning of the 15th.

Dr. Branham did not see a single yellow-fever case, nor did he inspect a single infected vessel. It is remarkable that yellow fever prevailed extensively among the colored people and the assumption that the disease was introduced by the colored ballast laborers, who after performing their duty in discharging ballast of infected ships, immediately and freely visited the city, is the most probable explanation of the cause of the epidemic.

As will be seen by the reports, vigorous disinfection of the first infected premises, depopulation of limited areas and guarding the same, were carried on with apparently favorable results. August 17th, Sanitary Inspector John Guiteras arrived to assist in the preventative measures. On the 8th of September, there having been but three deaths, and fifteen days having expired since the last death, on recommendation of Surgeon Hutton, the report of Sanitary Inspector Guiteras that he had "finished an examination of the cases of fever existing at present and none were suspicious," and the report of Passed Assistant Surgeon G. M. Magruder stating that "there seems to be no cause existing for continuing the quarantine," orders were issued to raise the quarantine.

In the meantime, all arrangements had been made for the rapid construction of a detention camp at Waynesville, Georgia, twenty-five miles

distant, under the direction of Surgeon Hutton, which was completed, ready for occupancy, by September 2d. On September 10th, Surgeon Hutton was obliged to be relieved on account of physical debility.

On the evening of September 13th, two additional deaths from yellow fever were reported by Sanitary Inspector Guiteras, in one of which a certificate of death from consumption had been given. Instructions were immediately telegraphed to employ necessary help for quarantining and disinfecting the infected localities. Passed Assistant Surgeon Geddings arrived, under orders, September 16th. Surgeon R. D. Murray was ordered from Key West quarantine (Dry Tortugas), arriving there September 18th, and reported a strict cordon established. The postmaster general was requested to have the mails from Brunswick disinfected. Train inspectors were appointed at Jesup and Waycross. Passed Assistant Surgeon Geddings was ordered to assume command of the detention camp at Waynesville. The railway companies were instructed to sell no tickets south of Atlanta; and on the 16th directions were given to open the camp immediately and make it the only outlet from Brunswick. On the 17th the disease was declared epidemic by the Brunswick board of health. On the 18th Dr. Paul Von Seydeweitz of New Orleans was ordered to Atlanta to consult the railway authorities and to prevent Brunswick refugees from going south. The camp was officially opened September 18th, under the immediate command of Passed Assistant Surgeon Geddings, Surgeon Murray being the officer in command of all measures in the infected districts. At that time there were twenty known cases in various portions of the city. In addition to the land cordon, a guard of six men with boats as a day and night patrol was established on the Cumberland river to prevent refugees going to Florida by water. Guards were also stationed with boats at convenient points on the main land and on the adjacent islands to intercept refugees going north by water, the cordon thus being made complete both on land and on water.

A number of physicians of reputation who had themselves had yellow fever and had experience in treating the disease were immediately sent to Brunswick to assist in the management of the epidemic. The details connected with the management of the epidemic will all be found in the reports of the several officers; but in general it may be stated, that Surgeon Murray with a full corps of accomplished surgeons and an experienced hospital steward was in command within the city, and that his efforts to prevent the contagion reaching other portions of the country were supplemented by the assistance of the revenue cutters at Beaufort and Savannah carrying medical officers of the Marine Hospital Service, patrolling the water-ways north of Brunswick to inspect the guards stationed therein, and in one instance capturing a boatload of refugees and carrying them to the neighboring National quarantine station at Blackbeard Island, to undergo a period of detention.

October 4th, Surgeon H. R. Carter, who had been temporarily trans-

ferred for duty in Washington, was ordered to Waycross with the triple object of inspecting rumors of yellow fever prevailing in various localities to which Brunswick refugees had resorted; to intercept any refugees who might escape through the cordon lines; and to establish a system of train inspection which would permit the railroads to continue traffic without interruption from the sanitary authorities of the various small cities alarmed at the possibility of infected persons coming within their borders.

This service on the outside of the infected area was a new feature in epidemic management, and proved very efficacious. It will be seen from Surgeon Carter's report that thirteen places were inspected by him, in which it was feared yellow fever existed, and his authoritative statement relieved the communities of the suspicion which rested upon them. Surgeon Carter was assisted by Assistant Surgeon J. S. Nydegger, and a corps of fifteen sanitary inspectors.

The epidemic was declared at an end November 25th. The detention camp was closed November 30th. The total number of yellow fever cases in Brunswick during the epidemic was 1,076, with forty-six deaths. The disease prevailed at no other locality except Jesup, which, as shown in Surgeon Murray's report, became infected before the disease was declared epidemic in Brunswick.

The following is an extract from the report of Passed Assistant Surgeon H. D. Geddings, in charge of the detention camp near Waynesville, Georgia:

The camp was officially opened for the reception of refugees from Brunswick, Georgia, on the 18th of September, 1893, and closed by the order of Surgeon R. D. Murray, M. H. S., permitting the return of all refugees to their homes in Brunswick, Georgia, November 30th, 1893. Four hundred and thirty-one persons availed themselves of the privileges of the camp, of whom about two hundred and twenty-five were white, and the remainder black and colored. The site of the camp, selected by Surgeon W. H. H. Hutton, was twenty-three miles west of Brunswick, immediately upon, and on, the south side of the Brunswick and Western Railway, and upon an eminence about twenty-five feet above the general level of the surrounding country, which is generally swampy, and within a mile of the margin of what is locally known as the Buffalo Swamp. As is usual in this section, the elevation was covered with a dense growth of yellow pine, scrub oak, and black gum trees. The soil was a gray, sandy loam, overlying a stratum of yellow clay, and the natural drainage of the site in all directions was good.

On my arrival I found that, under direction of Surgeon Hutton, an area two hundred feet square had been cleared of trees and undergrowth, and at the four angles of this square, rough, but substantial buildings had been erected, which were used respectively as kitchen, white and colored dining rooms, guard room, quarter-master's store-room, executive office and telegraph office, and commissary. A depot and baggage room were provided at the railway. Along the line connecting the buildings, at an interval of twenty feet, were placed wall tents 12x14 feet with flies, and subsequently further rows of tents were pitched behind these, and opening on streets fourteen feet wide. All tents were provided with substantial floors, raised six inches above the ground, and the following equipment was provided:

For each inmate—one spring wire bottomed cot, one cotton mattress, one hair pillow, two sheets, one pillow case; and for each tent—two tin wash-bowls, two tin cups, and two wooden chairs. Remarkable ingenuity was displayed by the inmates in construction of articles of furniture from packing cases, waste lumber, etc. The tents proved of good

quality in service, and quite comfortable in all weather. It is suggested, however, that any further tents be constructed with a wall, eighteen inches or two feet higher, and of one foot greater pitch. A hospital establishment of two buildings was provided at a distance of one half mile from the camp. The following routine was observed, the calls being given by the bugle:

5:30 a. m. Reveille and attendants' breakfast.
6:00 a. m. Breakfast.
8:00 a. m. Sick call.
12:00 m. Dinner.
4:00 p. m. Sick call.
5:00 p. m. Supper.
Sunset. Retreat and call to quarters.
9:00 p. m. Tattoo.
9:15 p. m. Taps (extinguish lights.)

The meals were substantial, abundant, and as varied as possible. In all cases, women and children were served at the first table, and the races were served in separate dining-rooms. The following rules were announced and seemed to work well in practice:

1. At reveille all inmates will rise and prepare for breakfast.

2. All quarters must be clean, floors swept, and beds made up before first sick call.

3. Meals will be served in the dining room only, and at stated hours, and no meals shall be carried from the dining room to any quarters, except upon the written order of the medical officer, renewed from day to day.

4. At sick calls, all inmates will repair to their quarters, and there be visited and inspected by the medical officer, who will prescribe and advise as he deems best.

5. All suspicious cases of disease shall be isolated at once, and until such time as their nature may be determined.

6. All cases of infectious diseases will be treated only in the hospital provided for the purpose.

7. No baggage from infected localities shall be brought into camp until disinfected by such process as may be directed, and only such wearing apparel as may be deemed absolutely necessary will be brought into camp after the disinfecting process.

8. All wearing apparel shall be a second time disinfected before discharge from camp.

9. Any person taken ill between the two sick calls, shall notify the nearest guard, who will in turn immediately notify the medical officer.

10. Guards are enjoined by their vigilance, to prevent the commission of any nuisance near any quarters; should such nuisance be discovered, the inmates of the nearest quarters will be required to police the same under the supervision of the guard, who will report the fact.

11. Inmates will confine themselves to the inner lines of the camp after retreat (sunset) call.

12. While innocent enjoyment will be encouraged, the strictest propriety of conduct will be demanded and enforced.

The discipline of the camp was, in the main, good throughout. But two confinements for misbehavior were required during the whole duration of the camp.

All baggage was submitted to steam disinfection upon arrival at, and departure from, the camp. The apparatus used was devised by Surgeon Carter, M. H. S., and constructed in a baggage car, the steam being supplied by the locomotive.

In addition to other duties, nearly sixteen hundred cars, boxes and flats, were disinfected for the B. and W. railway, sulphur fumigation being used for boxes, and drenching with solution of bichloride mercury (1–800) for flat cars. This disinfection of cars enabled the traffic into Brunswick to be carried on with a minimum of delay and hardship.

Two cases of yellow-fever occurred among the inmates of the camp; one resulted in recovery, one in death. Both cases occurred in the persons of sailors who had arrived at Brunswick on vessels trading there, and both would seem to show a period of incubation of at least five days, thus justifying our detention of ten days.

Following are the rules for train inspection service, enforced by Surgeon Carter:

Inspectors will allow none to board a train, unless with a certificate, between Waycross and Savannah.

If certificate can be examined before boarding, without detention of train, it must be done, and if unsatisfactory the person presenting same will not be allowed to board.

After boarding, the certificate and the person must be carefully examined, and the inspector assures himself that the passenger is not recently from Jesup or any infected locality.

If the passenger is known to be a recent resident of Jesup or any infected locality, or to have been in such place at any time during the past two (2) weeks, he will not be allowed to board, even if he has a certificate.

If, after boarding, either the certificate or the examination of passenger is not satisfactory, the passenger will be turned over to the city authorities at Waycross or Savannah, or at the place where he desires to stop, if between those places, and the facts noted and reported.

A record will be kept of the names of all passengers inspected, name of signer of certificate and his rank, date of inspection, date of certificate, and place of boarding train, and where passenger is bound and what disposition is made of him, whether passed or turned over to local authorities; also any other facts worth notice.

Inspectors will aid local quarantine authorities in any way in their power consistent with their duties, and give them any information, and obey all local quarantine regulations.

It only remains to be noted that the cost of the measures taken by the government in and around Brunswick was about $73,000 exclusive of the new quarantine plant.

The Marine Hospital Bureau has had constructed and now ready for use in any epidemic, two portable disinfecting machines; one a sulphur furnace with fan blower and necessary pipes for the disinfection of a portion, or the whole interior of a house; the other a steam chamber of sufficient length and width to receive a mattress. Each apparatus is on wheels and may be readily drawn by two horses, and both are constructed after special designs including the most recent developments in practical disinfection.

I cannot close this paper without commenting upon the sad necessity which occasionally arises in the United States of resorting to the above described methods of preventing the spread of yellow-fever. Unfortunately these measures work a degree of hardship to the people within the infected territory, but on the principle of the greatest good to the greatest number their enforcement, besides being necessary, is undoubtedly just. The question remains, however, how long have the people of the United States, particularly the southern portion thereof, to be subjected to the

possibility of such rigorous measures, and how long must the scourge of yellow fever continue to threaten? Are we to accept this constant menace as a necessary feature of Southern life? Or should we not transfer our energies from the battlefields of epidemics, as it were, and throw them into a campaign against the causes which produce the epidemics.

Now these causes are all practically one, namely, faulty sanitation of cities, a want of sanitary engineering, and the greater the want of sanitation in a given city within the yellow-fever zone, the greater is it as a source of danger. Yellow fever is not indigenous in the United States, but the conditions prevailing in many of our southern seaboard towns and cities are such that when introduced it may become nourished, grow strong, and overpower the people. It is incumbent on every state board of health in the South to leave no stone unturned and to work without ceasing until its cities and towns are supplied with perfect sewerage and perfect water supply. In the past, yellow fever was a menace to the cities of the North as well as to the cities of the South. Now it gives but little concern on the Atlantic coast at ports north of Baltimore. Is there any plausible explanation of this other than that the sanitary conditions, in other words, the drainage, the sewerage, the water supply of cities of the more Northern states, have been greatly improved? As a preventive, therefore, against the spread of yellow fever, sanitation of Southern cities is of vital importance.

But while we may thus cast the mote out of our own eye, we cannot be indifferent to the beam which is in our neighbor's eye. Within sixty miles of our coast of Florida there is an island between which and the United States intimate commercial relations exist. Naturally salubrious, by reason of marked indifference to municipal sanitation, it constantly maintains yellow fever in its harbors and on its shores. You all know I refer to the Island of Cuba and particularly to the port of Havana. Let our Southern cities be ever so perfect in their sanitary arrangements, the danger constantly threatening from Havana and other Cuban ports, from Vera Cruz and other Mexican ports, from Rio de Janeiro and other Brazilian ports, would still be great enough to keep us in a state of perpetual alarm. The attention of sanitarians of the United States should be directed to this place of the yellow-fever situation and the subject should be agitated until some ameliorating response is received from these neighboring countries.

REPORT OF THE INTERNATIONAL COMMITTEE ON THE PREVENTION OF THE SPREAD OF YELLOW FEVER.[1]

By FELIX FORMENTO, M. D., Chairman, New Orleans, La.

Mr. President and Fellow Members of the American Public Health Association: At the meeting of the American Public Health Association, held in the city of Mexico, November, 1892, in accordance with the recommendations contained in the president's address and on motion of Dr. Eduardo Liceaga of Mexico, an international committee was appointed "On the Origin, Causes, and Development of Yellow Fever and the Proper Means to Stamp it out at its Birth."

The intention was that this committee should be composed of sanitarians and engineers from the different countries represented in the association, who were authorized to invoke, if necessary, the assistance of their respective governments. In presenting to you this first, incomplete report, your committee begs leave to express its regret that neither Cuba nor Brazil is represented on said committee because of their non-participation in the workings of our association. The absence of engineers from the committee is also to be regretted.

We have endeavored to remedy these deficiencies, as far as possible, by requesting the most prominent sanitarians and experts of those countries to give us their views on this vital question and to indicate the sanitary measures, the local reforms, they considered most urgent and effective; we are sorry to say that so far no reply has been made to our request.

But before entering into the discussion of the means and measures that may be suggested, let us consider briefly the natural history, causes, and nature of the disease. This study may assist us in our researches.

Yellow-fever is, as you know, a disease of a special type, of exotic origin. Primarily developed in the tropical regions of America, more particularly in and around the Gulf of Mexico, it has spread gradually to other parts of the American continent, and, only exceptionally, to Europe and the west coast of Africa. It has never been observed in East India, nor in China. Shortly after the second landing of Columbus, in 1493, a large number of his men were reported to have died of an unknown fever, producing jaundice of a deep saffron color, which disease has been considered by many ancient authors as yellow fever. It is, however, impossible to state with precision the first occurrence of yellow fever in a coun-

[1] Read before the American Public Health Association at its meeting in Montreal, Canada, September 25, 1894.

try just then discovered, and at a period of general ignorance. It seems that the disease was first positively observed and recognized towards the end of the fifteenth century in San Domingo and Porto Rico, thence invading other Mexican gulf and Central American countries. During the seventeenth century it extended along the coasts of the Atlantic as far north as Providence and Boston. It prevailed quite extensively in the latter city in 1693. In 1700 it was quite fatal in New York and in 1793 a frightful epidemic occurred in Philadelphia, causing 4,000 deaths during three months, in a population of 40,000 inhabitants. In 1761 it was first introduced in Havana, where it has prevailed permanently since.

In the beginning of this century it extended from America, across the sea, to the Canary Islands, Gibralter, Barcelona, Lisbon, and Leghorn. It has since been repeatedly carried to ports in Great Britain and France, but has never spread into those countries.

Up to the year 1853, the disease had only shown itself in seaports and in localities not far from the sea. In that year it spread to cities and rural districts in the interior, at great distances from the seacoast, and invaded the states of Louisiana, Alabama, Florida, Mississippi, Arkansas, and Texas. The type of the disease was most malignant and the mortality very great; there were not less than 8,000 deaths in New Orleans.

The same extension of the disease was noticed during the epidemics of 1867 and 1878. In the latter, the whole of the Mississippi valley was invaded. The total mortality was about 16,000. The epidemic of 1878 was the last extensive visitation of yellow fever in the United States. It was undoubtedly due to importation from Havana to New Orleans by the steamer *Emily B. Souder*.

Since the early part of this century it has never prevailed epidemically in the north, there having been only occasionally a few imported cases.

In our Southern states, epidemics have continued to exist almost every year up to 1878. In the space of sixty years there were not less than forty-eight epidemics in New Orleans, twenty-eight in Charleston, twenty-two in Mobile, seventeen in Pensacola, nine in Savannah, and seven in Galveston, and a number of less importance, such as that of Tampa, Florida, in 1887, Brunswick, Georgia, in 1893, etc. During a period of sixty-one years, from 1817 to 1878, yellow fever existed more or less every year in New Orleans, except from 1862 to 1865, during which four years all commercial relations were suspended on account of the war and local sanitation was greatly improved under military regime.

The permanent central focus of yellow fever is localized in certain countries in and around the Gulf of Mexico, particularly Vera Cruz and Havana, in which places it prevails during the whole year. It made its first appearance in Brazil as late as 1849, since which period it has reigned almost constantly during certain months of the year, in cities and towns along the seacoast, from Bahia to Santos. According to Professor Barata, of Rio Janeiro, yellow fever disappeared entirely from that city,

from 1861 to 1869, when it was reimported by an Italian ship from San Iago. These infected or reinfected localities have thus become secondary foci of development and irradiation.

We reproduce here from Dr. J. C. Le Hardy's paper on yellow fever published in the *Virginia Medical Monthly*, June, 1894, a very interesting tableau giving the years of the different visitations of yellow fever in our principal cities :—

Boston was infected in 1693, 1798, 1802, 1805.

Providence was infected in 1797, 1802, 1805.

Portsmouth was infected in 1798.

New London was infected in 1798.

Staten Island was infected in 1798.

New Haven was infected in 1802, 1805.

New York was infected in 1702, 1745, 1791, 1795, 1796, 1798, 1799, 1800, 1801, 1803, 1804, 1805, 1806, 1807, 1809, 1819, 1820, 1821, 1822.

Philadelphia was infected in 1699, 1741, 1744, 1747, 1762, 1793, 1794, 1797, 1798, 1799, 1802, 1803, 1804, 1805, 1820, 1853.

Baltimore was infected in 1794, 1797, 1800, 1802, 1805, 1818.

Norfolk was infected in 1795, 1800, 1801, 1803, 1805, 1821, 1826, 1852, 1866.

Charleston was infected in 1699, 1713, 1728, 1732, 1739, 1745, 1748, 1762, 1792, 1793, 1794, 1795, 1796, 1797, 1798, 1799, 1800, 1801, 1802, 1803, 1804, 1805, 1806, 1807, 1817, 1819, 1824, 1827, 1828, 1835, 1838, 1839, 1843, 1849, 1852, 1854, 1855, 1856, 1858, 1862, 1864, 1871.

Savannah was infected in 1817, (?) 1820, 1854, 1858, 1876.

Pensacola was infected in 1817, 1822, 1825, 1827, 1828, 1834, 1839, 1841, 1842, 1843, 1845, 1846, 1847, 1856, 1867, 1873, 1874, 1875, 1878, 1884.

New Orleans was infected in 1817, 1819, 1820, 1822, 1829, 1832, 1833, 1837, 1839, 1841, 1847, 1848, 1849, 1852, 1853, 1854, 1858, 1863, 1864, 1867, 1870, 1873, 1874, 1878.

Galveston was infected in 1839, 1842, 1844, 1847, 1854, 1858, 1859, 1864, 1867, 1878, 1882.

We will refer to the tableau later on.

Although the disease has exceptionally been observed in high altitudes where it was evidently imported, yellow fever may be said to belong essentially to low sea coast regions. Whilst endemic in Vera Cruz, it is entirely unknown in the mountains of the interior and in the city of Mexico. Cases imported from Vera Cruz to the capital, have never been known to develop new cases at such altitude. The same phenomenon has been observed in San Domingo, Jamaica, etc. It exists on the seacoast; it is unknown in the mountains.

Yellow fever respects neither race, age, or sex. The negro is, how-

ever, less subject to the disease than the white or the mulatto, and the mortality among the blacks is generally very small. In the Bahamas, the mortality of the whites was fifty-nine per thousand; that of the blacks, fifty-six per thousand (La Roche). About the same proportion was observed in our Southern States, except during the epidemic of 1853, in which the relative mortality was much higher. Men are attacked in greater number than women, probably because more exposed to infection on account of their habits, occupations, imprudence, etc.; the mortality is also greater among them. Infants and young children seem less subject to the disease. We will refer later to the so-called immunity of the native-born, children and adults.

The existence of yellow fever, outside of its endemic *foci*, is always due to the introduction of the disease germs, either by persons or through infected articles, clothing, bedding, baggage, cargoes, ballast, etc. The principal local conditions favorable to the development of the disease are a certain latitude, 40 degrees north to 30 degrees south, a low soil, the sea coast, prolonged high temperature (80 degrees to 90 degrees), large gatherings of foreigners or unacclimated individuals, bad sanitary conditions, no sewerage, defective drainage, decomposed organic matter, accumulation of filth of all sorts, bad water, etc.

The fact that for such a long period of years, yellow fever prevailed almost every summer in many of our Southern ports, New Orleans particularly, gave rise to the opinion so long entertained by physicians and the public that the disease was endemic in the South, that it belonged to our soil, hence was created for New Orleans the almost universal reputation of its being a permanent focus of yellow fever, constantly threatening the whole country . . . this opinion, we are sorry to say, is still shared by a few prejudiced persons.

Among our own Southern people, and until a comparatively recent date, the majority of laymen and physicians believed in the local, endemic origin of yellow fever . . . This explains the little interest then taken in all questions of quarantine, the marked opposition so often manifested on the part of legislators and the people to all restrictive, prophylactic measures. The whole question of quarantine was in a complete state of uncertainty and demoralization. For a succession of years, quarantine was alternately established and abolished by state laws. Following a virulent epidemic, attributed to foreign importation, a new zeal would at once develop in favor of protective measures, and the quarantine of the time, with a long period of detention and no true disinfection, would then be most rigidly enforced . . . The next change in public opinion would cause the abandonment of all quarantine restrictions. Petitions and counter-petitions, for or against quarantine, were constantly being addressed to the legislature. This deplorable confusion was not limited to the general public, it likewise extended to the medical body. Physicians were divided into two classes, those who believed in the local origin

and those who believed in the foreign importation of yellow fever, in other words, those opposed to quarantine and those in favor of it.

Not later than 1879, a special committee appointed by the Medical and Surgical Association of New Orleans, to consider the preventive measures to be taken against yellow fever, reported as follows:

"We believe yellow fever to be a specific disease, due to a specific cause, exotic in its origin, now domesticated among us, and which does not require a new importation to give rise either to sporadic cases or to epidemics."

The uncertainty and confusion existing in the past in regard to the origin of yellow fever exist fortunately no longer, and nowadays we could hardly find a single physician, acquainted with the history of yellow fever, who would contend that the disease ever originates in any part of the United States.

Since the scientific and really efficient system of quarantine inaugurated by the board of health of Louisiana has been generally adopted, yellow fever may be said to have disappeared from our shores. Fourteen years' experience and observation have demonstrated that it is now in our power to prevent its introduction in our country. During this long period of time, scarcely a summer has passed without a few cases being brought to our Mississippi river quarantine station, from some Mexican gulf or Central American port, and yet, with one exception which occurred in November, 1889, two days after the removal of quarantine restrictions, not once has the disease been observed in New Orleans. This fact cannot be due to the unimproved local sanitary conditions. It is due solely to our greatly improved quarantine system. Yellow fever never originates in New Orleans; its occurrence, whether in a sporadic or epidemic form, has always been due to repeated, direct importation, or, in rare cases, to the hibernation of the germs throughout a mild winter.

We have had during this summer additional conclusive evidence that yellow fever does not belong to our soil, that it never originates in New Orleans. Never in the history of that city has there been more digging up of soil, more upturning of earth, more tearing-up of streets on account of electric railways being built in every section of the city; never has there been such deep excavations necessitated for the construction of sewers—a new feature in New Orleans, from which much is expected; the cleansing of canals, etc. At no time has there been such an accumulation of putrescent material resulting from the non-removal or improper removal of garbage, etc.; the summer has been hot and damp, the number of unacclimated persons unusually great; yet, in spite of all these unfavorable sanitary conditions, there has not been even a suspicious case of fever. Formerly all digging and up-turning of the ground were considered as certain of engendering yellow fever; to-day it is known the disease does not originate there, and all excavations are allowed to proceed during the summer months, with a few sanitary measures of precaution, and the public health is not the least imperiled thereby.

The nature of the specific infectious agent of yellow fever is not yet well known, nor have the several micro-organisms, which have been described as its specific cause, been satisfactorily demonstrated. There can, however, be no doubt as to the existence of such living micro-organism. Analogy with other infectious disease germs, forces us to admit it. Yellow fever, like rabies, cholera, typhoid fever, and diphtheria, whose specific microbes are well known, is due to a specific germ, always identical, susceptible of reproduction and transportation. The disease is not contagious, in the true sense of the word, but rather infectious, transmissible by infected material. Wherever this germ finds certain special conditions of soil, climate, temperature, etc., favorable to its development, and persons susceptible to its infection, it develops and propagates *ad infinitum*. It is possessed of great vitality, like many other germs, and may remain in a latent state for an indefinite period, only needing favorable circumstances to develop. There are numerous instances of the disease declaring itself in a locality where it had never existed, after the introduction of merchandise coming from an infected place or the unloading of an infected ship. We will recall here the introduction of yellow fever in Saint Nazaire, France, by the ship Anne Marie, from Havana (1860) and in Madrid (1878) by the opening of a trunk containing the effects of a soldier who had died six months before, in Havana. In both cases the disease did not spread beyond the first cases, which resulted from direct exposure to the infection; there were no secondary cases, the local conditions not being favorable to its development.

Formerly, when yellow fever was thought to be of local origin in New Orleans, the consensus of opinion was that the natives, or Creoles, having been accustomed to the poison since their birth, were not susceptible of contracting the disease. They had become acclimated either by their long sojourn in the country without ever having had the disease, or had had it in a mild or modified form in their early infancy. The local origin theory naturally led to the immunity theory. In fact, up to the year 1853, every epidemic seemed to confirm the belief in the immunity of the native Creole. For instance, in 1841, out of a total of 1,800 deaths there were only five deaths reported among the Creoles. In 1843, out of 692 deaths from yellow fever, but 29 persons were certified as having been born in New Orleans (Dowler). It may have been that many natives—children, especially—were reported as having died of a pernicious, congestive, or malarial hemorrhagic fever, when they had died in reality of yellow fever. Be this as it may, this belief, this dogma, in the absolute immunity of the native Creole was destined to be soon ruthlessly overthrown. Theories and opinions, however cherished and consoling, could not long subsist in presence of observation and facts. Physicians had been struck by the fact that during epidemic years, while adults were dying in large numbers of yellow fever, the mortality among young children was unusually high. In most cases, the deaths of those children were attributed to

convulsions, meningitis, pernicious or malarial fevers. Many practitioners, in their desire to explain this simultaneous large mortality among adults and among children, did not hesitate to admit the co-existence of two epidemic diseases, one affecting the adults, yellow fever; the other, the children, malarial hemorrhagic fever.

But the epidemics of 1867 and 1878 were destined to bring about quite a change in medical and public opinion. A more impartial and enlightened observation of facts began to throw light upon a subject which had remained obscure and confused. Prejudices, from which medical science is not always exempt, had to yield to reason and a more accurate interpretation of the facts. Reliable statistics furnished by our best observers, demonstrated beyond a shadow of doubt, that children born and raised in New Orleans did not enjoy the privileged immunity from yellow fever which was the boast of our forefathers; that during those epidemics they died in large numbers of the same identical disease that killed the adult foreigner. Clinical observations and pathological studies settled forever the controversy existing up to that time among local physicians. We were then able to give a satisfactory explanation of a fact which had long been noted, namely, that the mortality among the children as well as among newly imported foreigners was in proportion to the interval existing from one epidemic to another. The longer the interval, the higher the mortality. Immunity was not conferred by birthright, but by previous acclimatization. How could our children, as well as newly imported foreigners, become acclimated to a disease which was not endemic and to whose influence they had not been exposed?

But even in those countries where yellow fever is undoubtedly endemic, Havana and Vera Cruz, for instance, the fact that natives are not exempt from the disease is now well established. Immunity, with very few exceptions, can only be acquired by a previous attack, mild or severe, of the disease.

Our friend, Dr. Daniel L. Ruiz, of Vera Cruz, a most prominent physician at the head of a large hospital, who recently died in that city, left a memoir, which has just been published. Among other interesting statements, he mentions numerous cases of yellow fever observed by him in natives of Vera Cruz, of all ages, from infancy to advanced years. He mentions by name, two young boys, eleven years old, of distinguished Vera Cruz families. One native and permanent resident died at the age of fifty; another was taken sick and died after thirty-five years' residence. He cites two persons who died after having suffered a previous attack in Havana. He says that certain physicians, in deference to local prejudice and dogmatic opinion of the past, will to this day persist in distinguishing the fever of the natives, known as hepatitis acuta, typhus of a special type, etc., from the dreaded vomito negro which attacks foreigners. At times, they even condescend to give the name of yellow fever to the former class, reserving that of vomito negro to the latter exclusively. "Clinically and pathologically," says Dr. Ruiz, "the diseases are alike; they cannot be

differentiated, and are always and only observed during epidemics of yellow fever." He alludes to the doctrine of former years, to the custom which then prevailed of women coming from a distance to be delivered in Vera Cruz, in order to confer to their children absolute future immunity against the dreaded vomito.

Looking over the tableau we have given of the numerous epidemics which have prevailed in the United States, with the date of their last visitation in each locality, we notice that there has been a gradual disappearance of the disease wherever the local conditions have been greatly improved by proper sanitary measures. We also notice that, during the last century, and first part of the present one, northern cities suffered much more from yellow fever than southern cities of the Gulf and Atlantic coasts. Commercial relations of more or less extension with yellow fever ports may in a measure account for this fact.

While epidemics gradually disappeared in the North, they became more frequent and fatal in the South. From 1851 to 1878, there were 30,984 deaths from yellow fever in that section of the country; during the whole of that period, the disease did not show itself North.

Boston was infected for the last time in 1805; New York in 1822; Philadelphia, with one exception, in 1820; Baltimore in 1818. Great sanitary improvements have been since made in those cities. Adjoining lowlands have been drained, raised, and cultivated; the streets have been paved, a proper system of drainage and sewerage established, garbage, nightsoil, etc., regularly removed, abundant supply of pure water procured, etc. In other words, the local conditions have become entirely modified by the enforcement of laws of hygiene. The same measures have been successfully carried on in Norfolk, Charleston, Savannah, and Memphis. As far as New Orleans is concerned, we are sorry to say that there has been but little progress made in its sanitary conditions. The immunity it has enjoyed since 1878 is due entirely to its system of quarantine, which has prevented the introduction of the foreign pestilence.

We believe the same measures which have given such splendid results in so many of our northern and southern cities, apply equally as well to those countries wherein the disease is endemic. To strike at the root of the evil, it would be necessary to destroy, to prevent the development of the germs of the disease in its very cradle, in those morasses, pools, marshes, and stagnant waters of the Mexican coast, of Cuba, of Central America, of those Islands of the Gulf, in which they originate. To accomplish this would require, no doubt, extensive and costly engineering work, which could only be indicated by sanitarians residing in those foci, and carried to successful completion by the governments of those countries. In presence of the wonderful achievements of modern sanitary engineering, can any one dare say such a thing is impossible? For our part, we firmly believe in the realization of this great sanitary transformation—perhaps in a near future.

Would it not be proper for this association, representing as it does the whole North American continent, to bring this vital question before the governments of those countries and urge them to prompt and energetic action? Could not this be done through the regular channel of diplomacy, by the intervention of our governments?

In the mean time, much remains to be done in the line of prophylaxis.

We know that the germs of the disease are given off by the bodies of yellow fever patients, and can be transmitted by infected material. We know that these germs require for their development and multiplication, certain conditions, which are, in a measure, under our control. We should, therefore, direct all our efforts towards destroying the infectious element in the sick-room by the disinfection of excreta and of all articles which may have become infected. We are in favor of cremation of bodies and contaminated material, whenever practicable. We should endeavor by every possible measure, to improve, to transform the sanitary conditions of all towns and cities, in which yellow fever prevails or is apt to be imported. We have seen what local sanitation has accomplished in our country. Happy results have been likewise secured by even imperfect enforcement of sanitary measures, in localities where yellow fever is endemic. Since the sanitary conditions of Vera Cruz have been improved, the ravages of the disease are much less serious than formerly. We are informed by an old, respectable resident of Colon, that yellow fever is less frequent and fatal in that locality since the cutting down of forests along the lines of the trans-continental railroad, and projected canal, and other local improvements.

In conclusion, we will here reproduce a few extracts from a recent communication from our distinguished confrere, Dr. George M. Sternberg, which fully embody the views of your committee:

"In view of all the facts, it appears to me probable, that, as in typhoid fever and in cholera, the infectious agent is contained in the discharges from the bowels, and is not given off from the surface of the body or in the breath, as is the case of those diseases which are recognized as being communicated by personal contagion. It is quite probable that the infection of bedding is due to its being soiled by the discharges from the bowels, and it is possible that when such infectious material, attached to blankets for example, becomes dessicated and is given off as dust, the disease may be directly communicated to susceptible individuals who respire an atmosphere containing such dust. However this may be, we have ample evidence that the seeds of the disease may be conveyed in such infected bedding, and, under favorable circumstances, may multiply indefinitely outside of the human body. The most favorable nidus for the development of such germs appears to be a soil saturated with organic material of animal origin, or decomposing masses of nitrogenous organic substances. This being the case, our efforts should be directed to the destruction of all such material in localities where the disease is endemic, or where it is likely to be introduced, and where temperature conditions are favorable for the propagation of the germ. The comparative immunity of northern cities, such as Philadelphia and New York, which suffered severely from this scourge during the last century, we believe to be largely due to improvements in the general sanitary conditions of these cities, and especially to the fact that excrementitious material is removed through sewers and the soil is covered by buildings, pavements, etc. On the other hand, those portions of the city of Havana, and of Rio de Janiero where yellow fever prevails through-

out the year, present more or less extensive areas of a polluted soil, uncovered by pavements and furnishing a favorable nidus for the development of the germ. In Havana, especially along the margins of the harbor, such areas exist and filth of all kinds accumulates upon the surface. A good sea-wall along the entire city front would be a very important sanitary improvement for the city of Havana, and in place of the wooden walls, under which filth may accumulate, there should be walls of masonry. With this improvement, the paving of unpaved streets, and a careful removal of all organic refuse, together with isolation of the sick and disinfection of excreta, we think it not improbable that yellow fever might be banished from the cities mentioned, and from other endemic foci of the disease."

Such are the views of your committee. We suggest that additional efforts should be made by this association to secure the coöperation of the governments of Cuba, Mexico, Brazil, and Central American Republics so highly interested in the vital question of stamping out yellow fever from this continent.

CONTRIBUTION TO THE STUDY OF YELLOW FEVER.

Presented to the Committee by Dr. EDUARDO LICÈAGA, Mexico, Mex., President of the Supreme Board of Health of Mexico, Professor of Surgical Therapeutics in the National School of Medicine, Director of the Maternity and Infant Hospital, Member of the French Society of Hygiene, etc., etc.

At the meeting of this association which was held in Chicago in the month of October, 1893, I had the honor of presenting a paper with the same title as this. I had this paper translated and forwarded copies to the physicians residing and practicing on the coast of the Mexican Republic, both on the Gulf and on the Pacific side. Some of my colleagues have had the kindness to answer the letters which I addressed to them; and in this short paper I propose to make use of the data with which they have furnished me, most of this information confirming the statements contained in my first paper, but some of them rectifying what I have there said.

It will be rememberd that in that paper I attempted to set down with exactitude the localities which may be considered as *foci* of yellow fever, and that under that character I designated Veracruz, Alvarado, Tlacotalpam, Laguna, Campeche, and the district situated to the north of the peninsular of Yucatan. I also stated that Drs. Mendizabal and Contreras did not consider that the towns of Alvarado and Tlacotalpam should be considered as *foci*. I must now add that, in the opinion of Dr. N. del Rio, an intelligent physician resident in Veracruz, the disease reaches the two towns I have mentioned from the port, with which those other towns are in daily communication by land and sea. Dr. Garcia del Tornel, who has lived twenty-five years on the coasts of the Atlantic and Pacific, is of the same opinion.

Dr. del Rio is of opinion that neither can Campeche be considered as a focus of yellow fever, and he founds this opinion on the fact that the disease had never appeared there, except when there has been a large agglomeration of people who had not been acclimatized. But as these circumstances have only been found on the arrival of troops from the interior of the republic, who have necessarily passed through the port of Veracruz; and as on the other hand there is almost absolutely no floating population in the port of Campeche, we can come to the conclusion that yellow fever, whenever it has presented itself in Campeche, has been of an epidemic character and transported from some other place, rather than it is epidemic and originating in the same locality. From these remarks

we may conclude that the only places which ought to be considered as *foci* of yellow fever are: Veracruz, Laguna, and the districts which are situated in the northern part of the peninsula of Yucatan.

As I consider it will interest the members of this association to know the rate of mortality caused by yellow fever in Veracruz, *the principal focus of the disease in the Mexican Republic*, I herewith refer to the curve of mortality pertaining to the years 1868 to 1893.[1]

Dr. Iglesias, a physician now residing in Veracruz, and who formerly practiced on the Pacific coast during the years 1885 to 1888, confirms my statement that *not a single case of yellow fever has spontaneously presented itself on that coast;* but, as stated in my previous paper, there was an epidemic during the year 1883, which was brought to the port of Mazatlan by the Pacific mail steamer *San Juan*. Dr. Iglesias states that both Drs. Rupeto Paliza and Ramon Ponce de Leon of Culiacan showed that that epidemic, which was not recognized by either the inhabitants of the coast or the physicians, neither of whom had ever seen it, was yellow fever of an exactly identical character to that which is observed in Veracruz. Dr. Iglesias says there was nothing extraordinary in the epidemic having spread to Culiacan, which is fifty kilometres distant from the coast, and to Hermosillo, which is one hundred kilometres from the coast, as similar facts are observed on the Gulf coast.

The third point which I touched on in my paper of last year referred to the localities on the coast which have been invaded by yellow fever, indicating at the same time the causes of such invasion whenever the proper data could be obtained.

Besides the places which I mentioned, Dr. Iglesias speaks of the districts of Cosalá and San Ignacio in the state of Sinaloa; but he lays down a fact which I cannot pass over without remark, as it may have some importance with respect to the etiology of yellow fever and it is the following: The epidemic of yellow fever spread in 1883 to the towns in the districts I have mentioned; but in the town of San Ignacio, which is the chief town of the district of the same name, although many persons arrived there with the disease on them and there stayed until it terminated, they did not in any way propagate the epidemic. It is to be noted that San Ignacio is not more than seventy-five kilometres from the coast, whilst Cosalá is situated at a distance of one hundred kilometres, that both these towns are situated at about an equal altitude over the sea level, and that the only difference that can be seen between the two, is that in San Ignacio the subsoil consists of a compact rock, whilst that of Cosalá only contains rock at a great depth. Amongst the towns in which the epidemic has appeared, Dr. Iglesias also mentions that of Papantla, where they have had one epidemic, which was carried there from Veracruz by the Fourth Batallion of Infantry. The epidemic principally developed itself amongst the soldiers of the Fourth Batallion

[1] Pamphlet by Dr. Iglesias.

which carried it there, and spread to the Twenty-first Batallion and to the detachment of Rural Cavalry who had marched there from the table-land, it being noted that very few of the towns-people were attacked by the disease.

In my previous paper I referred in the fourth place to the immunity which is enjoyed by those individuals born in the places in which yellow fever assumes an endemic form, and to the reasons for that immunity. I first laid down, as a universally accepted fact, that the individual who has once gone through an attack of yellow fever is safe from any further attacks. This first proposition I find to be fully confirmed in the papers by Drs. Garcia del Tornel, del Rio, and Iglesias. That this immunity is acquired after having suffered a severe attack of yellow fever, or even a slight or abortive attack, is confirmed by the observations of the physicians I have mentioned and of Dr. Guimaräis, professor of the faculty of Rio Janerio, who exhibited to Dr. Garcia, in the infant asylum, different cases of fevers, apparently ephemeral, undeveloped and intermittent, which the professor called "acclimatization fevers," because, in his opinion, they were not more than abortive forms of yellow fever. He supports this opinion by the results of a post mortem on a little girl of three years, who was attacked by one of those fevers, but died of croup, and in whom, nevertheless, the anatomo-pathological symptoms of yellow fever were found.

Dr. del Rio says: "The theory developed by yourself with respect to the immunity enjoyed by the natives, is supported by the opinions of almost all the physicians of Havana and Veracruz, and is proved in an irrefutable manner by the facts. That this immunity can be lost is very true, but such cases are very rare, and so exceptional is the case that you have cited as related by Dr. Garmendia, that I have often heard it spoken of as something very extraordinary, and I have even doubted the correctness of the diagnosis. The old gentleman in the military hospital, of whom you speak in your paper, was Mr. Ortiz de Montellano, who passed many years in Jalapa and in the capital of the republic, some doubts having remained with respect to the diagnosis of the first attack."

Dr. Iglesias says: "With respect to the natural immunity enjoyed after undergoing a serious or abortive attack, my opinion entirely agrees with yours."

As I supported my statement that this immunity is acquired in early infancy, with the fact that the ladies of Veracruz who may be residing outside of that city, return to the port in order to bear their children, so that they in turn may acquire that immunity, and as this assertion has induced Dr. Iglesias to believe that I am of the opinion that the immunity is acquired by the mere fact of being born in a focus where yellow fever is endemic, I must declare that this was not my idea, and that I am convinced that only by means of a serious, mild or abortive attack of yellow fever, can immunity be secured with respect to an after attack of the same disease.

The other question that I touched on in my last paper, was as to the most efficacious manner of acquiring an artificial immunity, either by means of the preventive inoculations of Dr. Carmona y Valle, or those which have been proposed by Dr. Sternberg. With respect to the former, Dr. Garcia del Tornel says in his pamphlet above mentioned, that he has employed the preventive inoculations of Dr. Carmona; that in order to render them absolutely inoffensive, he found it sufficient to add one milligram of carbolic acid for each two centigrams of urine which was evaporated.

During the year 1883, in which Dr. Garcia del Tornel was fulfilling his duties as military physician on the Pacific coast, that being the time when the epidemic of yellow fever appeared among the towns of that region, he specially dedicated himself to making preventive inoculations among the soldiers and civilians who would accept them. "What risk was there," says the doctor, "what harm could be done? What else could I or ought I to do, if only to quiet the panic in those districts? It was not a question of curing the sick, which is always the one sole, indivisible, and unavoidable duty, but that of introducing the recently recommended vaccination, and of proving its preventive action in the very places in which the epidemic was reigning. I certainly suffered something from professional sneers, both then and after; but I have not the slightest difficulty in saying, that both my soldiers, as well as the great majority of the civilians who were inoculated, escaped from the epidemic, with the few exceptions that are naturally to be expected.

"These surprising results I communicated in 1884 to Dr. Felipe Martinez, of Mazatlan, and to Dr. Praslow, a physician who enjoys great reputation in Culiacan. I do not think that they acted on my indications.

"When in 1884 and 1885, I found myself at liberty to travel, I visited the towns of Culiacan, Bltata, La Paz, Guaymas, and Hermosillo, advising all my professional brethren to employ Dr. Carmona's inoculation, and myself inoculating everybody who offered himself.

"The Carmona inoculation has continually furnished me with improved data to extol its excellence.

"In many circulars, I have advised all the physicians residing on that part of the Mexican coast which lies between Tampico and Progresso, to adopt the system of inoculation of Dr. Carmona; I myself have practised inoculation here, in Tuxpan, Tampico, Veracruz, Coatzacoalcos, Minatitlan, Jaltipan, Chinameca, and Acayucan, these three last towns being those which were invaded by yellow fever in 1892, in spite of the assertions of Mr. Garfias, but I always found great opposition on the part of my colleagues."

Dr. del Rio, of Veracruz, does not appear to be of the same opinion. In the pamphlet I have quoted, he says: "The preventive inoculations of Dr. Carmona deserve all the respect that is due to that illustrious name; and if I cannot say anything theoretically, as I do not consider myself in the position to criticise the work of the great master, I cannot say that I have found any favorable results in practice, as is proved by the accom-

panying table which I have received from the military hospital of this garrison, and which shows the results of inoculation by the Carmona system. It cannot be denied, that the imperfections incidental to all new methods must have contributed to this negative result, but I do not doubt that when perfected, it will result in great benefit."

Dr. Carmona has occupied himself already with the figures contained in the table referred to by Dr. del Rio, and I merely fulfil my duty as a relater in showing the opinion of Dr. del Rio.

Impartiality also obliges me to mention here the objections which Dr. Iglesias presents to Dr. Carmona's last publication respecting the preventive inoculations against yellow fever, in which that professor rests on the opinion of Prof. Bouchard, of France: "In whose opinion certain infectious diseases throw out in solution, and in the urine, principles which are capable of reproducing the disease, and that, consequently, vaccination can be practised with the urine of patients who are suffering from those diseases, and thus avoid the disease from which these substances proceed."

Dr. Iglesias says: "That up to the present date, this has only been demonstrated with respect to five diseases, that which is denominated the bactericidal condition of the humors and tissues, and are produced by the picoyanic bacillus, the carbon bacteridia, the symptomatic carbon bacillus, the cholera vibrion and that of Metschinikoff, has yet to be proved with respect to yellow fever, and to attempt inoculations with the urine of persons suffering from that disease, as claimed by Dr. Carmona, or as indicated by Dr. Sternberg, before ascertaining the existence of the bacteriacidal condition of the humors in the latter, does not appear to me in accordance with scientific principles, and I think that before establishing a method which shall be above all criticism, it is necessary to found it on a study of solid facts, and not on conjecture or deductions which are founded on an analogy which has as yet to be demonstrated."

As the object of a paper of this character is not to enter into a discussion, but is rather of a practical class; and, as Dr. Carmona's inoculations have given good results in the hands of some physicians, I consider it my duty to insist that they should be submitted to experiments on a large scale, and under uniform conditions, so that we may form a decision as to their practical utility, or inutility.

"The international committee on the prevention of the spread of yellow fever," was appointed by the American Public Health Association, with the object of seeking the disease in its origin, and attacking it in its home itself. The contribution, which, as a member of that commission I bring, can be set down in the following propositions:

1. The only endemic centres of yellow fever in the ten thousand kilometres of coast pertaining to the Mexican republic on both seas, are Veracruz, Laguna, and the district situated in the northern part of the peninsula of Yucatan.

2. The most efficacious manner to prevent the propagation of yellow fever from these centres to all the immense coast of the republic, consists in the exact compliance with the provisions of the amended sanitary code, and of the maritime sanitary regulations, as well as those which have been laid down for the delegates of the supreme board of health in the ports, laws which are now in force in this same republic.

3. The best way of preventing the development of yellow fever in the centres of endemia, or its propagation in localities which are favorable to its development, are to undertake the sanitation of the towns, and the furnishing of waters which shall be bacteriologically pure.

I accompany this paper with a copy of the laws and regulations to which I have referred.

DISCUSSION.

Dr. H. B. Horlbeck.—I have listened to the report with a great deal of pleasure, and highly enjoyed it. There are some points in reference to it that are striking. We do not find from that report a single pathognomonic symptom of yellow fever brought to our attention. It is with that view that I make some remarks before I introduce a resolution to the Association. Yellow fever has prevailed for a number of years, a standing menace to all our territory. We will have it down in our southern country for six months in the year, May and November, and it is always a menace to the public health. I do not think we can accomplish much in the way of prevention until we are better acquainted with the nature and cause of the disease. It is of immense importance that someone should be deputed, preferably a young man of scientific attainments, who will devote himself and his life to this end. I do not know of any organized systematic work of this character that is being carried out. I therefore offer the following resolution:

Resolved, That the American Public Health Association, recognizing the constant menace to the health of a very large territory of this country from yellow fever, recommend to the governments of the United States, Canada, and Mexico, the great necessity for a continuous bacteriological investigation of this disease, and suggest that they collectively, or separately employ an expert bacteriologist to permanently reside in one of the infecting centres where yellow fever continuously exists, for the investigation of the nature and causes of the disease.

CAR SANITATION.

By JAMES PATTISON, M. D.,
Chairman Províncial Board of Health, Winnipeg, Manitoba.

THE PRESENT SLEEPER.

Everyone knows that the aim of the car-builder of the present day is to make the sleeper a palace on wheels. The seats are upholstered with the softest material, combined with reasonable durability, the carpets are the most velvety, the curtains soft and rich, the mattresses, pillows, blankets, and coverlets of the best. The whole furnishing of the car is similar to a private drawing-room, but the very opposite to that of the sick-room for infectious cases, as prescribed by sanitarians.

Who travel in these cars?

1. The healthy who are wealthy enough to afford the luxury, for the cars are certainly luxurious as compared with cars of lower grade forming the bulk of the train.

2. The delicate, who although free from any actual disease, are not blessed with the physical strength to enable them to stand a journey of one or more full days' duration in the ordinary car. From their delicate constitutions, inherited or acquired, they are supposed to be peculiarly susceptible to infection.

3. *Invalids*, for ease and comfort during the day, and the bed at night.

It is from this third class of travellers that the danger to the general public arises. No discrimination is made by those in authority as to the character of the disease from which they are recovering or suffering, and you find the convalescent, as well as those partially so, from all infectious diseases, except perhaps small-pox, sitting side by side, or in adjoining seats with the other occupants.

Tuberculosis is now ranked as an infectious disease, and tubercular patients travel more than any other class in search of suitable climate. Persons suffering from phthisis pulmonalis are to be met with in the sleepers upon nearly every trans-continental train. They cough and expectorate, as all such do, sometimes in the cuspidor, sometimes in the handkerchief, but very frequently on the carpet, as it is not their own. When on the last, the germ-laden expectoration becomes rapidly dried and ground into dust; rises in the air of the car and is inhaled by the susceptible fellow passenger; often an innocent stranger. It is quite rational to presume that in this way this fatal disease is often spread.

Again, as occupants of the same car, you will find parents with their naturally delicate children on the way to spend the summer at the sea-

shore or other health resort, and in the adjoining section, other parents with their children not quite convalescent, not yet free from the infection of scarlet fever, diphtheria, or some other infectious disease; clothed, in all probability, in infected clothing. Is it not likely the latter will impart the disease to the former family? No intelligent parent would allow such intermingling at home; no intelligent medical man would allow it. Yet probably both of these families were advised by their medical adviser to take an outing, and to take a sleeper for the sake of the delicate children. Those who have paid any attention are convinced these happenings are of every day occurrence all over this continent.

What, after a time, is the sanitary condition of the ordinary sleeper? It becomes simply a hot-bed of infection. It cannot be otherwise, for no efficient measures are taken to prevent it. The sheets and pillow cases are changed daily, sent to the laundry, allow that they are thus purified; what is done with the mattresses, pillows, blankets, coverlets, and curtains? They are closed up from sunlight and air in the upper berth, and for months at a time they are never exposed to nature's purifiers.

So far as the car itself is concerned, at the end of the trip, the carpet is swept, the cushions brushed, in a dry condition; a profusion of germ-laden dust rises to settle again; what falls upon the wood-work, and is visible, is brushed off with a duster to settle again on the carpets and cushions, where all remains in the most favorable condition to be raised into the air by the next set of passengers and the motion of the car upon the return trip. To my mind, the sleeper of to-day is an extremely active factor in the propagation of infectious diseases; more so on account of its luxurious furnishings than the colonist or other cars. From a sanitary point of view, it would be a great improvement, and easy of accomplishment, to have,—

1. The floors of polished hard wood with tight joints.

2. To abolish tight fitting carpets, and substitute rugs.

3. To adopt for the rugs, cushions, seat-backs, curtains, blankets, coverlets, etc., material and shades of color which will withstand superheated steam under pressure, and have all subjected to its action at the end of each trip. Railroad companies have always abundance of steam available at terminal points, and the expense of a proper chamber large enough to hold the seat-back, floor rugs, curtains, and bedding, should not be insurmountable by such corporations.

4. The whole interior of the car should be gone over with a germicidal solution at the end of each trip.

5. Each cuspidor should always contain a germicidal solution, and be carefully attended to.

6. A plentiful supply of paper or other cuspidors should be kept for use at night.

7. Expectorating upon the floor should be rigidly prohibited.

8. Invalids should present a proper certificate of freedom from infection.

Railroad companies are not allowed to carry the dead of infectious diseases except under certain conditions; why should they carry the living without any? It is the duty of national, provincial, and state sanitary associations to educate the people in matters of this kind. When educated, the people will demand protection, and when the people demand what is right and reasonable, corporations, which are said to have no souls, generally find it convenient and advisable to comply.

REPORT OF THE COMMITTEE ON CAR SANITATION.[1]

By G. P. CONN, M. D., Chairman, Concord, N. H.

A report upon this subject must include several topics, for in order to bring before the public a full realization of its importance, we must consider the construction, the heating, lighting, and ventilation of coaches, as well as the methods of car cleaning now in use by the managements of most roads.

This last is most essential, as it is the first principle of sanitation, without which nothing like a healthy standard can be assumed.

The problem of car sanitation is one of complex character, and involves so many mechanical questions that one can hardly be expected to bring out in a single paper. I have endeavored to get the opinions on this subject from other members of the committee, but have not succeeded in doing so, as for various reasons the different members have begged to be excused, therefore I have selected from the opinions of sanitarians and practical mechanics such quotations as seemed to have a concise, practical, and unbiased bearing, upon the conditions necessary to secure sanitation of passenger coaches.

In the design of a car for the transportation of people it is important that it be constructed with a view to stability, safety, and endurance. It must be constructed with a strength equal to the strain which is expected of it, in order that it may be safe to passenger and employé. This is important, for without strength and capacity for endurance, it would be a veritable trap to every one having anything to do with it. It is virtually and for the time being a house on wheels, in which the varying number of people are expected to make their homes for a longer or shorter period, according to the distance which they may be expected to travel. Therefore like a house it should be constructed upon sanitary principles, in which ventilation, heating, and such conditions as will allow it to be kept clean, are paramount factors in every case. Unless these sanitary principles can be carried out, and are made permanent, then this house on wheels becomes unwholesome and unhealthy, and the conditions become favorable to disease or of disseminating it, should a contagious or infectious malady find a place within its walls. Theoretically speaking, a room or a car into which a large number of people are to assemble should have left out of its construction everything that is calculated to foster or develop disease germs, therefore the plainer it can be made, the less upholstery, carpets, and curtains that are placed

[1]Presented at the Montreal meeting of the Association.

within, would seem to be the best calculated for health. Practically, however, the public demand something more than plain walls, and plain seats, and forget the conditions necessary for sanitation in their desire for luxury. This is an unfortunate circumstance, but it is necessary to deal with the problem as it exists. Probably cars could be constructed with much less expense on leaving out much of the draperies, etc., that are now considered necessary; but as the public demands the luxurious apartments which we find in all well appointed cars to-day, we shall be obliged to consider the different classes of coaches just as they now exist on most of our long lines of travel.

Referring to ventilation, it is now twenty years since the State Board of Health of Massachusetts instituted an investigation into the condition of passenger coaches. They found that the atmosphere of the ordinary coach contained from one to six times as much carbonic acid gas as other public assembly rooms, such as churches, theatres, and public halls. The same year, 1874, at the meeting of the Master Mechanics' Association, the master mechanic of the Boston & Albany and also of the Old Colony Railroad made a report on that subject. It was taken up by the Association and considerable discussion followed. Some improvements came from this action, but since that period the progress of ventilation in cars has not been rapid; in fact, it can scarcely be said that any improvements have been made. Recently, state legislation has placed the obligation upon the management of railroads to use steam heat, therefore the necessity of further improvements in ventilation has become apparent to every one. In ordinary weather during the winter, the problem of how to heat the car with steam and not have it too warm, is far more difficult in solution, than it is to prevent it from becoming too cold. These difficulties are largely due to the fact that the men who have charge of this work are incompetent to carry out the designs of the inventor of steam heat. They have little or no conception of what constitutes good atmosphere in a coach, and they care but little about their work except that the time goes on and they draw their pay. They have no instructor beyond the mechanic who simply shows them how to turn valves which admit the heat, and to shut it off, and the whole problem, as far as they are concerned, is how to keep heat enough in the car to keep it warm. The changing of the atmosphere of the car is of but little moment to them; they are constantly going in and out of the car at every station, and perhaps may be pardoned for not noticing the atmospheric condition that obtains throughout the train.

Another fact in car sanitation, and to me perhaps the principal one, as it involves every principle of sanitation, is absolute cleanliness. This may be impossible in coaches, yet a near approach to it need not be considered impracticable.

Cleanliness is the first principle in sanitation whether it be of cars or houses, and seems like a very simple matter. But when we consider

that it involves in its principles, cleanliness of atmosphere as well as material, then the problem becomes greater, for in keeping the atmosphere of the car clean as well as its floor and ceilings you have arrived at what may be called true sanitation. The problem of keeping a car clean is greatly enhanced by the fact that very many good people allow themselves and their children, when riding upon the trains, to become slovenly in their actions, throwing things upon the floor of the car that never would be permitted in an ordinary dwelling house. Why it is that people are so forgetful of good sense and good manners, when riding upon trains, is past comprehension; yet, we see it every day, and the coaches become excessively filthy from that cause alone. It may not be easy to break up such habits, yet, if the trainmen formed habits of cleanliness in regard to the coaches which are under their care, it would have a very beneficial effect on the passengers. In the Pullman and Wagner coaches, where porters are employed to wait upon passengers and keep the car clean, when the occupants so far forget themselves as to cover the floor or carpet with the refuse of orange, banana, or apples, nut shells, and other things which render a car unwholesome or unclean, and the porter goes around with his dust-pan and brush cleaning it up, it does not take a great many miles of travel for such people to see the error of their ways and to discontinue them. The same might be true of the ordinary coaches if the brakeman or person in charge should perform the same acts, for people naturally would become ashamed of throwing things upon the floor for another person to clean up in order to render the apartment comfortable.

Little need be said in regard to heating of cars, as that has become a question of legal importance. The accidents by fire became so numerous that the different state legislatures took it in hand, passed laws doing away with the ordinary stove, and substituting steam heat. Unfortunately there was no concert of action with different roads in the use of steam heat, as each road experimented for itself, the consequence being many different methods of transmitting steam through the cars. Which of these is the best, I am not able to state, but it is to be hoped that some uniform method will be adopted by which all roads will be able to effect interchange of cars, and that the instructions which trainmen should receive upon that particular subject, shall be so uniform that there will be no difficulty experienced in keeping cars properly warmed and well ventilated.

To digress a moment, I would add that it has been found necessary to open schools of instruction in the use of the air-brake, and I am told that old and experienced trainmen after attending these schools have been surprised to find how little they knew of the practical application of what was supposed to be merely an automatic machine.

Now this instruction is secured by fitting up a car with all the mechanism of the automatic brake, and having a thorough mechanic for a

teacher, and why not combine with that the teaching of car sanitation to the extent that the trainmen may fully understand how to use such devices as are now to be found on most passenger coaches.

In regard to the different systems of ventilation several experimenters and inventors have gotten up systems of their own, had them patented and endeavored to put them upon the market. Some of them are very complex and all of them require some knowledge of the subject or they cannot be made useful. All of them involve extra expense in the construction of a car.

The question of how to ventilate a car is one which the mechanic and the sanitarian must bring out together. It seems as though it would be quite impossible to invent any system that will change the air of a car while in motion, and at the same time be effective while it is standing still. With electrical power it may be possible to place fans in a car, the same as you do in a house, that will be effective when the car is standing still, but when the car is moving, the pressure of the atmosphere upon the outside is so great that considerable change will take place inside the car. Then again, this pressure of the atmosphere is so much different when the car is moving slowly than it is if the car is moving rapidly, that it brings up another point in the problem of ventilation to be solved by the practical mechanic.

Before the use of the power brake, the duties of the trainmen were almost constant and imperative, but with the advent of the automatic brake his duties were made much lighter and less exacting.

It is true that with the introduction of the various improvements that have been or may be instituted, a higher order of intelligence may be required than was necessary to assist in stopping or starting a train, yet that does not prevent the average trainman from doing good work, provided he has proper instruction.

The *Railroad Car Journal* publishes the report of the committee of the Master Car Builders' Association, from which I quote at length:

"In all modern systems of ventilation, sanitary engineers endeavor to have a plenum instead of a vacuum, or, in other words, to have a slight excess pressure inside of the building instead of a slight vacuum. With a plenum there can never be any cold drafts or admission of smoke, dust, or cinders, for the reason that the pressure would always be driving the air outward through every crack and opening. With a vacuum the reverse is the case, and dust, smoke, and cold air will find their way in at every crack. It is very desirable that the windows of passenger cars be so arranged that they can be locked fast in winter time; to prevent one obstinate passenger interfering with the comfort of the whole carload, but this can only be done when a sufficient supply of fresh air is constantly being furnished to the passengers, comfortably warmed. The opening of the doors at stations, is also a great interference with a uniform system of ventilation. This cannot be avoided, but the evil effects of it can be

largely overcome by building the cars with an inner swinging door. Most of the modern, larger passenger cars having smoking rooms, double saloons, and heating apartments, can be very easily fitted up with a swinging door at the end of the passage in between these compartments, which will act as a kind of air lock and prevent a good deal of discomfort otherwise unavoidable. A convenient way of arranging the windows, so as to avoid the drafts and interference to the comfort of the passengers in the winter time, would be to have the outer sash arranged, as is commonly the case now, with the inner sash arranged so that when lowered they will lock themselves tight and can only be released by a lever at the end of the car, attached to a locking bar running the full length of the car on either side. These windows could be kept raised in summer time, the outer sashes being so that the passengers can raise them or lower them as they please. In the winter time, when these sashes are lowered no windows could be raised.

"To summarize, the ideal conditions would be as follows:

1. "The admission of thirty cubic feet, per minute per passenger, of fresh air, and the carrying off of an equal amount of foul air, summer or winter.

2. "The fresh air so admitted must not be moving at a speed of more than three or four miles per hour in winter time.

3. "Fresh air admitted must be of a temperature in winter time of about seventy degrees Fahrenheit.

4. "Fresh air so admitted in winter time must have added to it a proper degree of moisture for the temperature at which it is admittted, according to the average humidity of the atmosphere, when at seventy degrees in the climate in which the cars are running.

5. "No system of winter ventilation can be successful unless means for the fresh air supply are provided independently of and separately from the windows and doors, as well as the ventilators for carrying off the foul air.

6. "The fresh warm air should be distributed through as many openings and as low down as it can be conveniently arranged for, and the foul air should be carried off through as many small openings in the roof of the car as can conveniently be arranged for in winter.

7. "The ventilation should be entirely independent of the speed of the train, and act equally as well whether the car is standing or running.

8. "The ventilation should be so arranged that there will be a plenum or slight excess of pressure inside the car, so that all drafts will be outward instead of inward, and smoke and dust thus excluded.

9. "It is most desirable that double windows should be used, and so arranged that they can be locked fast in winter time, but readily opened in summer time.

10. "It is most desirable that an inside swinging door be used, so as

to form an air lock or inside vestibule, to prevent the admission of cold air and dust every time the doors to the platforms are opened."

In arriving at these conclusions this committee had an investigation made under the supervision of an expert, and incorporated into their report something of his work, and the reasons for summarizing such ideal conditions as they have deemed necessary for perfect ventilation.

The committee add the following:

"It may be argued that there is no use for any such system of ventilation as this, that the present arrangements for the ventilation of passenger cars are good enough, and that nobody is any the worse for the present state of affairs. To show that this is an entirely wrong position to take, your committee had a number of tests made to show the degree of foulness of the air in sleeping cars, chair cars, and the day coaches, which tests have been made under the supervision of Mr. Wm. Forsyth, of the C., B. & Q., through the kindness of Mr. Rhodes. Pure air contains from three to four parts in ten thousand of carbonic acid, and at seventy degrees Fahrenheit an average condition of moisture would be from four or five grains of water per cubic foot."

"Dr. Angus Smith made a series of careful experiments in lead-lined, air-tight rooms for the purpose of seeing how long healthy people could exist in an atmosphere having an excess of carbonic acid and moisture. As a result of his experiments, it was shown that it was very unwholesome to breathe an atmosphere having more than seven parts in ten thousand of carbonic acid, and that an atmosphere containing ten parts in ten thousand could not be endured by delicate people for long without injury, and that as the presence of an excess of carbonic acid in a direct indication of the presence of micro-organisms, commonly called disease germs, the injurious effects are not merely limited to the poisonous influence of carbonic acid, but that the danger of taking organic diseases was very largely increased. It was further shown that the senses are a very unreliable guide in judging of the foulness of the atmosphere, and that people who remain in a room in which the atmosphere had become gradually fouled would hardly notice its foulness, whereas outsiders suddenly coming in would be almost suffocated."

"Micro-organisms, or disease germs, are not given off to any harmful extent in the exhalations of healthy human beings, but they are given off in large numbers in the breath and spittle and evaporation from the skin of unhealthy persons. Especially is this the case with people suffering from tuberculosis, whooping cough, fevers, and so on; and the disease germs grow and multiply very rapidly in a foul, moist atmosphere." To quote a prominent naval surgeon: "The road is short, straight, and sure, from vomica and mucous patch to the receptive nidus in another's body. Who that has ever had forced on him an aerial feast of cabbage, onions, garlic, alcohol, tobacco, and gastric effluvia of an old debauch, can doubt that aqueous vapor can transport microscopic germs by the same route?"

A. L. Gihon, M. D. Address before the Pan-American Medical Congress, Washington, D. C., 1892.

"Experiments made in Europe on animals which were inoculated with a preparation from the dust beaten out of the cushions of railroad cars in ordinary service, and which cars were not known to have carried sick people, showed that the most of these animals which were inoculated died of violent diseases. Few of them lived long enough to die of tuberculosis—none of them survived. As these micro-organisms are in the air and simply settle on the dust, it goes to show how very necessary indeed it is to carry off the foul air, and that, to quote a Southern physician, 'The movement of vast masses of people annually from one section of this broad country in search of those climatic influences modifying the course and progress of disease has become, from a sanitarian standpoint, a great unsolved problem, namely, that of accomplishing the proper ventilation of cars by the introduction of pure air, free from dust, cinders, smoke, and so on, and at the same time the withdrawal of the impure air arising from the natural emanations of the body, as well as the more serious dangers accruing from chronic or contagious influences.

"All these devices which depend upon the speed of the train for their action, and where the air intakes surround the stovepipe, every time the car stops the ventilating process ceases and may be reversed; at slow speed it will be almost inoperative.

"Great improvement could, however, be made in the condition of the air in our crowded passenger cars if the trainmen were compelled to pay proper attention to the ventilators; a regular set of instructions should be furnished for their guidance, and division officers should be instructed to pass through the train at every opportunity and report cases where the ventilators have been neglected and the air overheated or foul, to the division superintendent for discipline. The men would then soon learn to attend to this part of their duty. Sleeping-car companies should have a code of rules printed and posted in the cars, and their porters and conductors should be made to observe such rules. One specially important thing is not to open the ventilators on the windward side of the train, otherwise, with drop-sash or trailing-sash ventilators, down drafts and cross drafts are unavoidable."

The above extracts from the report of the committee of the Master Car-Builders' Association, has much to commend it to our notice, as it comes from the best and most advanced class of practical mechanics. As a rule such men are not visionary, but reason from cause and effect, therefore their opinions are entitled to our consideration. I understand the report was written by Master Mechanic Sanderson, of the Norfolk & Western Railroad, of Virginia; yet when asked his personal opinion of its being practical to carry out such ideas, and use the average trainman to accomplish the work, remarks in rather a sarcastic manner,—"I wonder what the A. R. U. or any other railroad organization would say if we

require our immaculate brakeman to do the chores in the railroad cars." [1]

Another member of this committee, when asked if he believed it was possible to carry out such an ideal system as the report would allow the public to expect would be in use in a few years, says,—"I would say in answer to your first question, that I do not believe, as a railroad mechanic, that it will be possible to introduce and have accepted by railroad managers, the ideal conditions in a passenger car as expressed in the paper that was read on this subject. I do believe that if our trainmen were educated to make better use of our present facilities there would be less complaint. They have been relieved from year to year of their former duties, until they feel that all they need to do is to wear a uniform." [2]

Undoubtedly this is true, and we are all the more ready to believe its truth after having once asked one of these uniformed "Mikados" to ventilate the coach. That look of pity and condescension makes an impression never to be forgotten.

In support of that part of the report which I have quoted—relating to experiment on animals inoculated with a preparation of dust from passenger coaches—I will give an extract from the report of scientists who have recently concluded a series of experiments, under the direction of the Imperial Board of Health of Germany, as to the danger arising from the dust in railroad carriages. Their results show a decided risk involved in traveling under the present sanitary condition of the coaches.

"The dust was collected in each instance from a square metre of surface, and from forty-five compartments, representing twenty-one carriages. The inoculations were made upon guinea pigs. Many of them died of various diseases, and the rest were killed. Three only were found to have tuberculosis. The number of bacteria was largest in the fourth class cars, and grew less with each rise in grade of the compartments. In the fourth class cars the number was estimated at 12,624 per metre; in the third class, 5,481; in the second, 4,247; and in the first class, 2,583. On the seats and upper walls the numbers varied in the four classes from 2,646 to 29, while the roof was almost free. Though the third and fourth class carriages were the most infected, it was much easier to clean them, as they could be washed with hot water and soap, which could not be so vigorously applied to the better class carriages owing to the carpetings and upholstery." [3]

The following letter, written on a trip to the Eastern states, says: "In our sleeper were three consumptives returning home to die, and that alone was depressing enough, but when, on getting up in the morning, one sees a considerable amount of dry, yellow sputum on one's vis-a-vis neighbor's bed linen, it is neither dainty nor reassuring. Morning cogi-

[1] Mr. Sanderson, Master Mechanic of the N. & W. R. R., Roanoke, Virginia.
[2] Mr. West, Master Mechanic, N. Y. O. & W. R. R., Middletown, New York.
[3] Boston Medical and Surgical Journal.

tations, usually so pleasant, are apt to turn to the uncomfortable possibility of all the bedding in the car being subjected from time to time to the same infection, and being probably imperfectly washed or simply rinsed. Then it is impossible to clean the upholstering and carpeting without taking them out of the car, and an infected sleeper should be dangerous as the continual vibration keeps the dust and bacteria in the air. The space is also necessarily confined. Moreover, travelers are apt to catch cold from drafts and from sleeping close to the windows, thereby rendering the mucous membranes receptive to germ implantation.

"They order these things better in Europe; on some of the continental lines special coaches are provided for consumptives, and these are constructed with particular reference to ready cleansing and disinfection at the end of every trip, which, it should be noted, are much shorter than the 'runs' in this country, and the need of precautions is, therefore, and for so much, greater here than abroad."[1]

Dr. S. S. Herrick, of San Francisco, read a paper before the section on state medicine, at the meeting of the American Medical Association the present year, entitled, "Common Carriers as Disseminators of Contagion."

The writer dwelt particularly on the disposal of excretion in the people on inland waters and on railway coaches; believing that certain communicable diseases whose contagious properties are discharged from the alimentary canal is liable to reach the alimentary or respiratory tract of other persons if not intercepted or destroyed, and cholera, typhoid fever, dysentery, intestinal tuberculosis and other filth diseases are notably transmitted in this way.

He says: "Companies who provide meager accommodations for passengers were properly censured, and should be held justly responsible if inadequate remedies were provided for their patrons."

Discussion by Drs. Ruggles and Cochran, Davisson and Stoner, all of whom were in accord with the opinions advanced by Dr. Herrick.

These men, while enthusiastic supporters of preventive medicine, are gentlemen of sound judgment and are not carried away by any desire for notoriety. They believe the state and federal authorities should be ever on the alert to secure health for the individual, and that it is a duty which they owe to the people of the country to have a watchful care over the transportation company as well as the municipal lines governing health officers.

The *Ohio Medical Journal* says of the prevention of consumption:

"We do not deem it wise or prudent to invade the homes of tuberculous patients for the purpose of securing disinfection or the isolation of the sufferer. The instruction of the patient and his household by the physician, in the necessity of prophylactic measures, is at present sufficient; but we believe that a vast deal of good might be done by the

[1] Dr. Douglass W. Montgomery's letter to the Pacific Medical Journal.

exercise of strict sanitary measures against the contamination of rooms in hospitals and hotels, and the berths in sleeping cars. The most careful cleansing and disinfection of apartments occupied by consumptives should be required before other individuals are permitted to occupy them."

As we have said before in this report, cleanliness is one of the first principles of sanitation; whether it be a car, a house, an office, or a workshop, the same principle holds good. In the construction of coaches for passenger use, something should be done to render the cleaning of the car a matter of small expense, for while in process of construction little things might be done that would add to their convenience, healthfulness, and cleanliness.

All passenger cars at the present time are constructed with water closets. The floor of such closets and a few inches of the side or mopboard should be covered with sheet copper, as an ordinary wooden floor will soon become filthy and can never be made clean. Odors will always be given off from an ordinary board floor whenever the temperature rises to that of summer heat; but if the floor be covered with sheet copper, hot water, dry steam, and chemicals may be used, leaving it without any absorbing surface to develop odors which may be latent in cold weather and very active on a hot summer day. If the designer and purchasing agent give attention to this in the first instance, the extra expense will be little or nothing, and will add very much to the efficiency of the car when the rules of sanitation are applied. As cars are now heated with steam direct from the engine, and as these pipes pass through water closets for the purpose of protecting them against the cold weather, I can see no reason why taps may not be placed in those pipes in water closets and used for the purpose of cleaning them with hot steam; and it certainly could be but very little extra expense at the time of the construction of the car.

Dr. S. S. Herrrick of San Francisco, Cal., in commenting upon a statute law of that state relating to maintenance or commitment of a nuisance, remarks:

"Obviously travelers themselves should not be held responsible for committing a nuisance, so long as transportation companies provide no facilities for obviating the same; and legislation should be aimed directly at these companies, holding them responsible and requiring them to provide an adequate remedy.

"It is well understood that the law must not ordain what is impracticable, and equally plain that no serious difficulty and expense would be involved in abating such nuisances. No mechanical difficulty exists for a steamboat or railway coach to have its closet provided with a closed receptacle, having suitable means for deodorizing, disinfecting, and ventilating, and for discharging the contents into some proper place at short intervals. The details of a contrivance suited to such a purpose

need not here be entered into. They belong to the inventor and mechanic, rather than to the sanitarian as such.

"Aside from considerations of health, it seems strange that respect for common decency has not abolished a practice in travel by land which would have brought a blush to common carriers in the good old days of slow coaches. While inventors and builders of palace cars are doing so much for the comfort and convenience of passengers in other respects, they adhere to a form of closet from which travellers must be excluded at the time when it would be most acceptable (halting at large stations) and which scatters filth and disease along the route. It is to be noted that cholera still lingers in Europe, and meanwhile we must not consider ourselves safe here within two weeks' travel by steam; while the other filth diseases, like the poor, are always with us.

"In my judgment the time has come for sanitarians to speak plainly and forcibly on the subject, and to demand of legislators a specific remedy which courts will be bound to apply to this class of offenses against health."

I understand several roads are making use of compressed air for the purpose of cleaning the draperies and plush covering of the seats, and that a plant for that purpose can be arranged to be effective with small expense. If this is true, and I see no reason why it is not, it should be generally used, for thorough cleaning with fresh air would be a most valuable disinfectant.

The vestibule train has become very popular, and no one doubts its efficiency as an easy riding coach, and insures perfect safety in going from car to car; but as an object lesson for the ventilation of cars it becomes a failure, inasmuch as it simply ventilates from one car to the other. Of course some air will pass into the vestibule section, but as that section has less width than the car itself, the pressure of the atmosphere extending to the car is much lessened than what it is upon the sides of the car itself, therefore but little air is forced in from that section of the construction, as the ventilating property of the vestibule is lost, and aside from that it may be overcome by the extra heat of lighting.

This leads one to consider the lighting of cars. Nearly every large road has been experimenting with the different methods of lighting coaches, and car companies like the Pullman and Wagner have done the same. Whether these experiments have been conducted in the light of sanitation, or as a question of expense, may be a matter of doubt, although it is probable that the safety of the car from destruction by fire has entered into the range of experiments. Gas and kerosene lighting while moderately expensive are not only dangerous by reason of their possibility of fire, but the extra heat which they occasion in the car in the summer time, proves a very serious obstacle to the comfort of the passengers. Then again, the destruction of oxygen by gas or kerosene lighting increases the amount of carbon dioxide in the atmosphere of the car, oftentimes to a

dangerous extent, and in that way the health of the passengers is seriously threatened unless there is a large amount of fresh air introduced continuously.

That electric lighting is the ideal of the present time perhaps no one will dispute, unless the expense of the same is taken into account. So far as I can learn none of the devices for electric lighting have yet been brought down to the maximum of the manager's idea of expense, and therefore some other method will find favor until the public demand safety in lighting as well as in heating coaches.

It would not seem that it would be necessary in a report like this to make any allusions to the water supply of railway coaches, but the Medical Society of New York has adopted a report, calling attention to the danger of drinking water from the average water-tank, as found in railway cars and other public places. Many cases of typhoid fever of mysterious origin, it is said, could be traced to the filthy water-tank, which has been filled with water and ice of doubtful purity, and refilled from day to day without cleansing. Nevertheless, people must have something to drink in hot weather.

From this we may learn that the public are critical regarding the water supply. Some years since, Dr. Reed of Ohio, in investigating this matter, found that the water-tanks of ordinary coaches, and sometimes those of palace cars, were notoriously filthy. The water supply must of necessity depend largely on the character of the supply at given points along the line. When cars are cleansed and the water-tanks refilled, the ice supply depends upon the same conditions, but there can be no excuse for filthy tanks any more than in public or private houses. There are enough men employed about the trains to see that every tank is made clean day by day, and not to do so, and thereby endanger the health of the traveling public, becomes criminal.

In conclusion I have but little to add, as until the use of such devices for lighting, heating, and ventilating as we now have are fully understood, and appreciated by the average trainman, who should be held responsible to his superior for the safe condition of his coach from a hygienic as well as a mechanical point of view, it is useless to assume that a more elaborate mechanism will find favor.

Nothing as yet approaching an automatic system in heating, lighting, or ventilating a car has been placed before the public, but as it is only a comparatively short period since automatic brakes and couplers have been placed upon the market, we may confidently look forward to the time when the public demand for hygienic improvements will evolve from the mind of man some plan or system to meet the emergencies of the occasion.

In order to do this effectually some one connected with the road would have to instruct the employé in the use of hygienic appliances, the same as is now necessary in the use of automatic brakes; and it would seem

quite practical that all roads having a surgical department, should extend this work into the domain of hygiene, and give the surgeon in chief authority to inspect, instruct, and to hold responsible such employés as are in any way concerned in maintaining a healthy condition of our trains. The surgeon more than any other person connected with railroads appreciates the hygienic condition of coach, stations, and grounds of our railroads, for in case of accident, he has much to contend with that is unknown to the physician and surgeon called to see those injured in ordinary accidents, and therefore will always be on the alert for all sanitary improvement.

However it may be brought about, the employé should be taught how to make the best use of all the devices in use to promote the sanitation of cars; and should be held responsible for any unsanitary conditions arising by reason of his negligence.

DISCUSSION.

Dr. Albert L. Gihon.—I wish to take up only two or three minutes of your time. I wish to say that the problem of car sanitation has been solved, and absolutely so; and there are many here who witnessed the solution of that problem. If you will recollect at the Charleston meeting, when Dr. Horlbeck took us on an excursion in a ventilation car, you will recall going into a smoking car where fifty men were smoking, and the atmosphere of the car was fit for any lady to enter. The air in the car was fresh and cool, without the slightest perceptible motion. The smoke went out from above; and it went out so vigorously, that a handkerchief could be drawn out through the vent. Why has not that plan been introduced into the cars? Dr. Horlbeck has been to the Wagner people personally, and to other manufacturers of cars, and they shrug their shoulders and do nothing. Why? Because these grinding corporations do not want to spend a few thousand dollars, out of the millions they make, to carry this thing into effect. This association should put itself in black and white regarding such matters of ventilation of cars. I, sir, came here in a miserable, unventilated Wagner car. I woke in the morning with a headache, from respiring foul air. Shall we submit to it any longer? Let it go abroad that it is the fault of these great companies, who do not want to spend a few thousand dollars to put an admirable system in operation in these cars. Another thing: our street cars are foul by the expectoration of all sorts of nasty, filthy people spitting on the floors; and our conductors do not attempt to prevent it. This is an important committee, and we have got to do everything possible to strengthen its hands, so that its work shall be disseminated far and near.

Dr. H. B. Horlbeck, of Charleston, S. C.—I desire to supplement a few words in reference to this matter of car ventilation. The greatest interest was manifested in the city of Charleston when an incorporated

body had a car fixed up with all the ventilation appliances. It worked successfully. It was used continuously in traveling many hundreds of miles, and never failed. It was what we consider a success. Wherever you took a handkerchief and put it where the inlet was for fresh air, it was gently moved. When above, it was drawn gently out. There was hardly any perceptible motion, and it was not unpleasant. It was a success in that respect. I had occasion to attend the Kansas City meeting, and on my way back stopped in and saw the Pullman people. I remained for a day. They treated me with great courtesy, and said they would look into the matter; but that has been the end of it. It will cost a considerable sum of money to change the cars, to put a ventilating apparatus in, etc. There will never be a successful movement in this direction until the public are forced to its necessity. Public opinion does not seem to be strong enough at the present time. Until the health authorities educate and impress upon the public the absolute necessity of such a thing, I do not think anything is going to be done.

Dr. F. Montizambert, of Canada.—There was one point about that car which impressed me very much; and if I take a moment to recite it, I am sure you will appreciate it. Dr. Gihon did not go fully into the particulars. There were from fifty to sixty of us in that car, who smoked vigorously when the apparatus was turned off; and when it was turned on, within a very few minutes the atmosphere was so clear that we could see from one end of the car to the other. In exactly six minutes the atmosphere was perfectly clear, the same as it would have been if we had been smoking to a similar extent in the open air.

Dr. Benjamin Lee, of Pennsylvania.—I am a non-smoker. Smoking on the whole is rather offensive to me. I was present at the experiment which Dr. Montizambert referred to, and I agree with the doctor that he and his friends performed their function most admirably, and I can also testify to the admirable results obtained.

Mr. E. C. Jordan, of Maine.—I was a member of the committee on car sanitation, and took in the trip referred to. In the report of the chairman of the committee, there is a supposition to the effect that there must be ventilation during the progress of the car, as well as when it is at rest. In examining into the nature of this apparatus, it was designed to ventilate the car only when in motion. We all know that when a car is in motion, the method now in operation, with the intelligent supervision of the brakeman, can be made to do very fair service.

Dr. G. P. Conn, of New Hampshire (closing the discussion).—Allow me to remark that I purposely avoided bringing into the report anything more than a casual mention of the systems of ventilation which have been proposed. There is none of them but what as sanitarians we can find some fault with, even the one Dr. Gihon brings up. Mr. Jordan says this car was designed for ventilation while in motion, but was of no practical use whatever when the car was at rest. Of other cars the same

thing may be said. It is important that we use some system of ventilation. Car manufacturers have already adopted something to that effect. There are transoms in the roof, or something similar above the doors. The windows are provided with certain screens and jutties, which prevent the introduction of dirt, but the trouble is, there is no one who is accustomed to their use or who has the intelligence and instruction necessary to look after them. Some roads have expended a great deal of money in order to bring out some system which was a fine thing on paper only. Dr. Outten, of St. Louis, assures me that the Missouri Pacific Railway have spent $25,000 on what he himself devised for ventilation without its being of any practical importance. When it was put into operation it was found to be practically useless. It simply shows that the mechanic and sanitarian must work together. What may be theoretically good may be practically *nil.* A good many systems have been proposed; some of them have considerable merit, like the Emerson system of Charleston, S. C., Pancoast, of Philadelphia, etc. All of them have some good qualities. Some of them have been introduced on different roads, but the results have been unsatisfactory simply because the train men have no knowledge of how to use them and they make a botch of it every time they try. The public are somewhat to blame themselves for uncleanliness and neglect in the matter of ventilation. They do various things on a train that they would not suffer to be done in their own houses. Things of various kinds are thrown upon the floor. They would not think of doing that in their own houses. Some passenger will insist upon having the window open, and the other will insist on having it closed, and so on through the car, and the average train man does not repel what is wrong and carry out what is right. I think, as has been suggested, to accomplish what we desire in this regard in the way of legislation we should have a federal head, a bureau of public health, which should take hold of such matters in connection with the Interstate Commerce Commission and bring about something valuable. I venture to say that if the railroad companies could be convinced that the comforts of passengers would be enhanced by the adoption of better ventilation methods, they would adopt them.

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INSTRUCTION IN HYGIENE IN SCHOOLS AND COLLEGES.[1]

BY C. O. PROBST, M. D.,

SECRETARY OF OHIO STATE BOARD OF HEALTH.

The last time this Association met in Canada, in 1886, we had the pleasure of listening to an able paper on the subject of the best method of teaching hygiene in the public schools, by Dr. Yeomans of the Ontario Board of Health. I have ventured to bring the matter before you again, not because I hope to add much to what was said on that occasion, but rather to remind you that but little improvement has been made in the manner of teaching hygiene in our schools since that time, and to urge that an effort be made to secure greater attention to this subject in our educational systems.

The state has assumed the right to enforce the education of her future citizens. The advisability of doing so will not be questioned; for not only the progress, but the continued existence of a free state depends on the general intelligence of its people. The state has assumed the right also to prescribe the kind of instruction that shall be given in the public schools, and has thus become responsible for the results of such education.

The trend of recent educational thought has been in the direction of encouraging the proper development of the physical body as an aid to mental advancement, though college athletics, through abuses, have recently been brought into disrepute. The state, so far, has done but little in this direction in her common schools, though some recognition has been given to the necessity for such training. We may confidently expect that at no distant day the state will consider it essential to provide

[1] Presented at the Montreal meeting.

for both physical and mental culture. Brawn and muscle united with brains are essential to advance her greatness.

Should the state stop here? Is it possible to give such instruction in the public schools as will save to the state for a longer time the men and women she has educated? We venture to assert that this is entirely possible by having hygiene properly taught in our schools and colleges.

An inquiry addressed to the commissioners of common schools of the various states reveals the fact that in nearly all states the laws provide that physiology and hygiene shall be studied in the common schools. This is true also as to the District of Columbia and all the territories. All the states were heard from excepting Idaho.

In the following states only is instruction in hygiene not compulsory, viz.: Arkansas, Georgia, Iowa, Missouri, Mississippi, Tennessee, Texas, and New Jersey. In Iowa some attention is given to the subject in connection with physiology. In Missouri any patron may, on demand, secure its introduction. In Texas and Virginia it is being introduced in the better class of schools, and is very generally taught in New Jersey.

This would be highly satisfactory if the subject were taught as it should be, but there is good reason to believe that this is not the case. It is not greatly to the credit of sanitary organizations that in many, perhaps most, of the states the introduction of hygiene into the schools was brought about by temperance organizations. In the majority of the states, and in all the territories, the law provides that physiology and hygiene shall be studied with special reference to the effect of alcohol and narcotics upon the human system. As might well be expected under these circumstances hygiene is mostly a side issue, and is so regarded, I fear, by many school authorities. While in no way disparaging this movement for encouraging temperance, which is itself a sanitary measure, it will be admitted, I think, by this Association, that a much broader and more useful field of hygienic instruction might be opened up for our future men and women. Indeed the aid and sympathy of our temperance reformers in extending the scope and purpose of such instruction may be fairly claimed on the ground that bad personal and home hygiene is a potent factor in causing intemperance.

Opinions will doubtless differ as to what should be included in instruction in hygiene in our schools. Is it necessary to teach physiology, and as much anatomy as will explain the functions of organs? The authors of most of our text-books on hygiene evidently think so, but the wisdom of it, and especially in the case of young children, may be doubted. It may be questioned whether it is advisable to teach hygiene to pupils in the primary departments, and especially in the manner usually taught. Little children get the most absurd ideas on the subject, as will be found by questioning them, and it would be much better if their fathers and mothers were the ones instructed.

It has been said that a man should not know he has such a thing as a

stomach; and individuals blessed with good digestion are usually free from disagreeable reminders of its existence. They cease to be so, however, when, from improper or badly cooked food, over-eating, lack of exercise, or other cause its function becomes deranged. He may be intimately acquainted with the anatomy or even the histology of the stomach, and may thoroughly understand the physiology of digestion, but such knowledge may fail to save a man from the demon of dyspepsia. Without transforming the school-room into a cooking-school, an intelligent teacher might impart to her pupils sufficient knowledge of how to eat, when to eat, what to eat and how to prepare it; all that is essential for the majority of men and women.

Our books on school hygiene take up the anatomy and physiology of the organs of respiration; but the need for pure air and the methods for obtaining it may be included without such knowledge. Useful and interesting object lessons are at hand in every school room and school building; the arrangement of the fresh and foul air ducts, with a visit to the furnace, if one is in use, methods of window ventilation, composition, temperature and humidity of the air, and a measurement of its carbonic acid, showing the increasing impurity of school-room air, could be made delightful illustrated lessons by an intelligent and interested teacher, and serve the purpose of firmly fixing in the mind the essential features of heating and ventilation, and the necessity of pure air.

The nature of the skin, with but brief reference to its structure and function, could introduce a lesson on personal cleanliness, including bathing and clothing. The boys would be specially interested in instruction for resuscitating the apparently drowned, which could be illustrated by two or three willing pupils.

The necessity, purposes, and right way of exercising could be dwelt upon in a way that would put point to the calisthenic exercises, which should be practised daily in our schools, and the need for continuing physical exercise in adult life be impressed upon the scholars.

When some loved pupil was stricken with a contagious disease the whole subject of its germ production, the manner of its communication, the necessity for isolation and disinfection, could be so presented as to make a lasting impression as to the production and prevention of the communicable diseases. The moral obligation of every person and family afflicted with a contagious disease to use every precaution to prevent from communicating it to others, should form part of the instruction under this head.

The relation of water supplies to certain of the communicable diseases and the manner of their pollution, with measures for its prevention, would naturally follow this lesson. Right methods for disposing of excreta, as well as other household wastes, and an abhorence for all that is filthy being out of place, could be inculcated without offending delicacy.

The care of the eyes, taking up the arrangement of windows and black-

boards, and the type used in printing their school-books, could be made of interest to the pupils, and serve to enlarge their view as to the care necessary to preserve the health of various organs of the body.

This by no means exhausts the useful lessons in hygiene that might be made interesting to school children; but enough has been said, it is hoped, to show that it is possible to impart to every child leaving our public schools sufficient knowledge of hygiene to enable it to avoid many of the conditions which lead to disease or premature death.

We have presupposed intelligent, interested teachers. As a matter of fact our teachers, though intelligent, are not particularly interested in hygiene. This, I believe, is largely due to the fact that the text-books they are compelled to use are uninteresting and unsatisfactory, and because they feel their lack of training in this subject. We must first instruct and interest our teachers. In doing this the teachers' institute affords a certain means of gaining open ears, and we may count on the assistance of all advanced school-men in any effort to increase the efficiency of teachers. State boards of health in conjunction with commissioners of schools could arrange for lectures on hygiene at teachers' institutes by capable men, and do much in this way. Locally, our health officers, aided by superintendents of schools, might arrange for a series of lectures to teachers, and thus interest them in a proper study of the subject. The coming teacher, who will more readily receive new ideas, may be reached in the normal schools, and these instructions should introduce an adequate course in hygiene, given by competent instructors. School examiners should be urged to require applicants for teachers' certificates to show a proper knowledge of the subject, and if state boards of health were permitted to prepare the questions on hygiene for the examination of teachers there would be greater assurance of their familiarity with the subject.

There are but few of our states that exercise any control over the sanitary construction of school buildings. The investigations in Massachusetts, New York, and other states show deplorable defects in a large proportion of school buildings. While it is of first importance that the health of pupils should be considered in school-house construction, the educational value of having such buildings planned and arranged in accordance with the best sanitary principles is worthy of consideration. No school building should be permitted to be constructed until the plans have been approved by some competent sanitary authority.

The appointment of a medical superintendent of schools in each school district would secure the proper oversight of schools and schoolhouses, as regards sanitary matters; and, if men properly qualified were selected, they could be of the greatest service in instructing teachers in hygiene.

Undoubtedly one of the greatest obstacles to proper instruction in hygiene is the lack of suitable text-books; and the wish has been repeated many times by both sanitarians and school-men that a satisfactory book should be produced. I very much wish some one as liberally

inclined to public health movements as Mr. Lomb would offer a prize for the best essay on How to Teach Hygiene in the Public Schools.

Hygienic instruction should not stop in the public schools. It should be continued during college life. It is surely of more importance to the average man, on taking up the active duties of life, that he should know how he may prolong it, and with continued vigorous health, than to be able to read Homer in the original. Should we not urge our universities, following England's lead, to establish the degree of Doctor of Hygiene? There is already a demand for men with such training—a demand bound to increase.

A word may be said in regard to the lack of proper instruction in hygiene in our medical colleges. I refer particularly to the medical colleges of the United States, for it is a pleasure to note that Canadian schools are giving considerable attention to this branch of medical education. It was not until the medical examining boards of one or two of the states of the United States demanded instruction in hygiene that many of our medical colleges introduced the study. It is to be feared that this was often *pro forma.* The subject is frequently taught in combination with another chair, and but little time is given to hygiene,—one lecture during the term, in one known instance. Even now, in perhaps the majority of colleges, no examination in the subject is required. Those familiar with work in medical colleges know how little attention students pay to subjects in which there is to be no examination.

Resolutions have been adopted by the state boards of health of Indiana and Ohio, urging medical examining and licensing boards of the various states to require that medical colleges, to be considered in good standing, shall devote not less than forty hours to the subject of hygiene, with an examination of candidates for graduation. The state board of health and the State Medical Society of North Carolina subsequently adopted resolutions urging medical colleges to devote not less than two lectures a week to hygiene, and requesting their board of medical examiners to "require of applicants for license the same preparation on this subject as on the other branches of medicine named in the Medical Practice Act."

A few months ago a letter was addressed to each medical examining and licensing board in the United States, requesting information as to their requirements in regard to hygiene, and asking whether it was considered "advisable and practicable for such boards to require medical colleges whose diplomas they accept to give a definite and suitable amount of time to instruction in hygiene, with examination of graduates." This question was answered in the affirmative by practically all of the correspondents. Answers were received from Alabama, California, Colorado, Connecticut, Illinois, Iowa, Kentucky, Maryland, Missouri, New Jersey, New York, North Carolina, North Dakota, Pennsylvania, Texas, Washington, and West Virginia.

In Alabama, Maryland, New Jersey, New York, North Carolina, North

Dakota, Pennsylvania, and Washington, diplomas are not recognized, an examination being required. Hygiene is one of the subjects required for examination in all. In California, Colorado, Connecticut, Illinois, Iowa, Kentucky, Missouri, Texas, and West Virginia, diplomas are recognized. In five of these, California, Connecticut, Iowa, Texas, and West Virginia, no requirement is made that hygiene shall be taught in colleges in order to be considered in good standing. In none of these states where diplomas admit to practice is there a minimum requirement as to sanitary instruction.

Those engaged in practical sanitary work can best appreciate the importance of having the practising physicians properly instructed in this subject. In most communities physicians are looked upon as an authority on all sanitary questions; but if they are in fact ignorant, and at the same time obstinate—an unhappy combination of attributes often met with—they frequently defeat the best efforts of the health authorities.

It is a maxim that education must precede legislation. Let us go then into the schools and colleges to urge on this great movement—the improvement of the public health. Let the new generation as they leave our schools and colleges be properly equipped for the life struggle by a thorough knowledge of the essentials of hygiene. We may then hope that as members of legislative and executive bodies, as householders and citizens, they will bring about the sanitary reforms which we now urge in vain. If the songs of the people may direct the destiny of a nation, much more may we hope that the proper teaching of hygiene in our schools and colleges will promote the public health.

THE HYGIENE OF VISION IN SCHOOLS.[1]

T. D. REED, M. D.,

LECTURER ON HYGIENE, MCGILL NORMAL SCHOOL, MONTREAL.

It has been found that the conditions of town life generally, and the conditions of school life in towns especially, are distinctly unfavorable to the development and improvement of the faculty of vision. Investigations in different countries have shown that with the yearly advance of studies in schools and colleges the number of defective eyes increases, from which we are forced to the conclusion that part of the price of education, as at present carried on, is damaging to the delicate organs of sight. How necessary therefore that the benefits of ophthalmic science should be afforded to the young as soon as education begins.

My plea is for the general introduction into schools, of the simple tests recommended by the Anthropometric Committee of the British Association for the Advancement of Science. Snellen's test types are to be used for testing power of vision, and Holmgon's series of colored wools for color-vision. The committee has issued a schedule of suggestions for the observations to be made, arranged in a manner within the range of an intelligent school teacher to apply.

Refraction and eye-strain having been attended to, there is another point I wish to present, and that is the possibility of educating the eye in rapidity and accuracy of action. The Indian and other aborigine accustomed to exercise his vision in endeavoring to see distant game or lurking enemies, acquires a sharpness and quickness of vision, much exceeding that of a modern city resident.

The town-bred child of civilization is but little called upon to exercise his vision on distant or minute objects, and therefore a low standard of visual acuteness is found to prevail, carrying with it of necessity a comparatively undeveloped power of observation. (B. Carter.)

Would it not be well to test systematically the vision of school children, and stimulate the exercise of it as a matter of competition? All the special senses are improved by exercise, and many of the physical disabilities incidental to town life have been diminished by the popularity and prevalence of physical education. Carter has presented this matter very ably before the British Institute of Public Health, at its congress in London of this year. He goes so far as to suggest that "prizes for accurate and extensive seeing should take a recognized place among those given at athletic contests, and the first steps in such a direction should be taken at school."

I have been in the habit of advising school teachers to have sight-matches, in this way: Let a number of articles be arranged on the desk

[1]Read at the Montreal meeting.

or table, and covered by a cloth; all eyes being directed to the table, the cloth is removed for a few seconds, and replaced; the trial then is to name the largest number of objects observed.

We all know that a lady will see more in one glance at a milliner's window than her brother will in ten observations of the same display; therefore let us stimulate the power of observation, commencing with the child at school.

TEACHING OF HYGIENE IN THE ELEMENTARY SCHOOLS.[1]

By DR. SERAPHIN GAUTHIER of Upton, Province of Quebec.

The subject which I am about to treat is of such importance for the cause of the propagation of hygiene among the popular classes, that I thought it my duty to lay the matter before this association by calling the attention of its members to the great necessity of teaching that science in our common schools.

Before proceeding further, however, I cannot but thank the government, the council of public instruction, and especially the members of the Council of Hygiene for their constant efforts towards diffusing the elementary laws of hygiene among the popular classes of this province.

Is it not a fact, Mr. President, that the man who causes a spire of grass to grow in a sterile soil is rightly considered a benefactor of humanity? With much more sense is a man who saves a life by the means of well-understood hygienic principles the object of our admiration and gratefulness.

To our worthy president, I have reasons to believe, is due the propagation of the science of hygiene, not only in our province, but, I dare say, in the Dominion of Canada, and we should certainly be grateful to him for his noble efforts in that direction.

That there exist in most of our rural districts a good many persons totally unacquainted with the elementary principles of hygiene, is a fact quite apparent, although it is to be seriously deplored; yet, when I see the same ignorance so conspicuously displayed by men occupying high social positions, I am not quite so surprised to find the same want of knowledge existing among the illiterate.

In the country where I live and where I have passed sixteen years of my life, practising the art of medicine, I must admit that I have encountered great difficulties in putting into execution the rules of the Board of Provincial Hygiene.

In several places, burying-grounds, immediately adjoining the church, and even with charnel-houses under the latter, are to be seen.

In my village, situated on the border of a river, the ground presents a well-marked declivity towards the shore; the bulk of the population is naturally massed around the church, which is situated on an elevation and having the river on the south-east, the cemetery at the back of it, the convent to the north, and the college to the west.

The natural drain of all these edifices winds its course towards that part of the village where the population is more dense, thus exposing it to the pestilential emanations of the surrounding establishments.

[1]Read at the Montreal meeting.

The infiltration of the cemetery water, which works its course through the cellars of the habitations towards the river together with the contents of the drains of the buildings mentioned above, is a real source of infection.

I myself was made the target of public vengeance when I protested against the erecting of a charnel-house in the cellar of the sacristy. I must add, gentlemen, that this plan was supported by the curé of the parish and approved by an able architect of the city of Montreal; happily, the authorities of the Council of Provincial Hygiene prevented the construction of such an abomination.

Now, our citizens are to construct an aqueduct. As regards the promoters of the project itself, they undoubtedly deserve to be congratulated; but, gentlemen, I feel confident that you will be very much surprised in learning that they omitted to utilize the same excavations for the drains.

If I mention the faults of my own locality, which is, by no means, the most unhealthy one in the province, it is to give you a fair idea of the deplorable state of things existing in many other similar places.

Of course, whilst the majority of the rural population do not understand the benefit of the hygienic laws well applied, I am bound in justice to declare that a certain number of our citizens fully comprehend its great importance.

Be it sufficient to mention all the earnestness shown during the memorable epidemic of 1885, when it was known that a case of variola had made its appearance amongst us. With the help of the municipal authorities combined with the support of a few citizens, anxious for the health of their families, I have been sufficiently enabled to isolate my patient, so that the terrible scourge could extend no further. I, nevertheless, had to fight the prejudices of our councillors, who not only pretended that all these precautions were ridiculous, but added, with all the authority of their science, that contagion did not exist and that it was nothing other than a Utopia of the medical profession.

In conclusion of all I have just stated, we must, at all cost, propagate the study of hygiene among the people. The best way to promote this project is to force its special study in the elementary schools and oblige the instructors to learn it by making it a part of the curriculum of academic studies.

The children of our present elementary schools are the future members of our society. They will occupy all the positions of our social life. They will be our successors and their memory will retain whatever they may have learned at their respective primary schools.

Their brain is easy to mould and when once cast, makes an indelible impression. That children like the study of hygiene I had ample occasion to ascertain personally.

Therefore, I hold that it is through the teaching of hygiene to our children, at the same time that we teach them religion by the aid of the Catechism (which is nothing more than the application of the moral laws

for the conservation of their tender souls), that we will eradicate the unfortunate prejudices which directly cause the loss of so many citizens, who might otherwise have been the strength, glory, and pride of our country.

Thanks be to the promoters of this idea! Glory be to them, for they have discovered the right way to diminish the alarming mortality we observe in the Province of Quebec.

I join my efforts to-day to cöoperate with these benefactors of humanity by insisting further on the necessity of applying, with more rigor, the laws ruling our province.

No sooner will the people fully understand the principles of this science, than we will cease to see the unpardonable negligence of parents in not having their children vaccinated; isolation and disinfection will be a safeguard against the propagation of epidemics. The municipal authorities will not be forced to proceed against those who blindly persist in sending their children to school when there exists a virulent disease in the family. The principle of contagion, which a great number deny, or at least pretend to deny, will have to be admitted; the ecclesiastical authorities will help to diffuse the light by teaching from the pulpit the measures, which must necessarily be followed, to arrest the epidemics, and the hygienic science will be recognized as the best and surest safeguard against a premature death.

We will not, then, see riots in the cities, as we have witnessed in 1885 in Montreal and St. Hyacinthe as a result of the application of the principle of compulsory vaccination. We will not see the health officer compelled to recur to the aid of a policeman in order to force the citizens to submit themselves to the law.

It is to be hoped that a case like that of the lamented Doctor St. Germain, of St. Hyacinthe, will not be repeated.

The good doctor was threatened to be shot during the exercise of his duty as health officer, while putting into force certain by-laws against smallpox. As a result of his noble and brave conduct, the nearly total loss of his clients followed, although during the whole epidemic he most generously treated the poor without the least remuneration. To the name of Doctor St. Germain respect is due. Death has taken him from his family, from his labors, and from his country; but his undying memory will ever be dear to us for in him we see a martyr who never flinched in the execution of his duties.

During the course of my experience as medical examiner I have had ample opportunity of verifying the above fact while questioning on the practice of medicine.

This important branch is only treated as a secondary matter, while it should be considered of first importance. My advice is that it should be put on the same footing as internal and external pathology.

Let us agree with Dr. Bilodeau, when he says that if we want our hopes of renovation not to be vain, if we are strongly decided to give our

elementary schools a new impulsion, and if, instead of ignorance, which still reigns in so many villages, it is to be succeeded by an era of progress, the teaching body must be everywhere of the standard that should be required.

I have shewn the necessity of teaching hygiene amongst the popular classes. Before concluding, however, I venture to remark that we do not attach sufficient importance to the study of hygiene in the medical universities of our country.

Since some years past our Provincial Government has not only shown a noble zeal in teaching agriculture in the agricultural districts of our country, but has also spent enormous sums of money with that end in view. Men of high social standing applied their talents towards the promotion of this grand cause as lecturers. Why would they not add another laurel to their glory and receive the gratitude of the Canadian people by delivering in the meantime lectures on popular hygiene ?

To instruct is to moralize, and this is best done by teaching the hygienic laws which tend to obtain the development and preservation of the physical forces.

I think I can best conclude, Mr. President, by borrowing the words of the immortal Juvenal,—*Mens sana in corpore sano*, "A sound mind in a sound body."

ON TEACHING THE PRINCIPLES OF HYGIENE TO THE YOUNG.[1]

GEO. G. GROFF, M. D.

MEMBER OF THE PENNSYLVANIA STATE BOARD OF HEALTH.

The importance of a knowledge of hygiene to every person has been generally recognized by educated people for nearly two generations, and as an appendage to physiology it has been taught for many years in the schools of America. It cannot be affirmed, however, that any great degree of success has attended this teaching, even in the hands of earnest and conscientious teachers. Why?

Two reasons may be offered for the failure of the instruction given in this important branch, viz.:

1. Lack of preparation on the part of teachers.
2. The absence of approved text-books on the subject.

Let us consider for a moment the ordinary preparation of teachers in this branch. If trained in the high school, the usual time given to the subject of "physiology" is one term of thirteen weeks. Of the average book on physiology, probably from one fiftieth to one one-hundredth consists of matter which may in any sense be attributed to hygiene. It will then be seen that a very small amount of time is given to the subject. In the normal schools of America, the time given this branch is just about the same as in the high schools. While mathematics and grammar will occupy the pupils every term all through the grammar and high school courses, periods of time varying from six to eight years, to "physiology" but a single term will be given. The normal schools of Pennsylvania are not different in this respect from those of the rest of America. A study of the curricula and teachers of these schools a year ago gave the following results:—

[1] Presented at the Montreal meeting.

DISTRICTS.	No. Students.	Teachers Grammar.	Teachers Mathematics.	Teachers Science.	REMARKS.
1st District......	800	6	9	1	
2nd "	979	2	5	2	Physiology taught by a physician.
3rd "	662	2	5	2	
4th "		1	1	1	Not yet opened.
5th "	360	1	2	1	
7th "	360		1	2	The science teachers devote but part of their time to their own dept.
8th "	579	2	2	1	Science teacher is also instructor in gymnasium.
9th "	666	2	2	1	
10th "	711	1	1	2	Assistant teaches history and zoölogy.
11th "	500	1	1	1	The science teacher is also teacher of ancient languages.
12th "	530	1	1	1	
13th "	526	1	1	1	Science teacher teaches grammar also.
12 schools........	6,673	20	31	16	

By the above table it will be seen that for 6,673 students some sixteen science teachers are provided, but in six instances these teachers give instruction in other branches, leaving but ten teachers devoting all their time to scientific instruction. The extreme illustration is seen in the first district, where fifteen teachers instruct in mathematics and grammar to one solitary teacher in science.

To instruct teachers in physiology and hygiene, it might readily be supposed that a person trained in medicine would be demanded, but only *one* such trained teacher is found in the twelve schools, as teacher of physiology. In these schools each science teacher has on the average 556 students to train, while but half that number are given to teachers of mathematics.

If from the strictly professional schools we now turn to the academies and colleges, which prepare a large proportion of the teachers of the state, we will find much the same condition of affairs. As a rule, the academies and seminaries can afford but a single science teacher. With the colleges, it is but little better, except that largely these institutions have been able to secure several professors for the scientific branches. The time given to the subject in colleges is not different from that in the high and normal schools, *i. e.*, one term of thirteen weeks in a course extending over four years. In not a few college curricula the subject does not appear at all. The college teachers of hygiene do not appear much more generally qualified in this subject than the teachers in lower grades of schools. And how could they be prepared, when it is certainly

within twenty years that hygiene has been taught in the medical colleges, so that even being a medical graduate would not necessarily mean that a man was qualified in this branch? In a word, it may be stated that to date, with a few honorable exceptions, scarcely any effort has been made to train teachers in this branch.

2. The text-books now in use are far from satisfactory. They are ordinarily compends of *anatomy*, *physiology*, and *hygiene*, of varying degrees of excellence, but nearly all of them agreeing in this, that anatomy is placed first in importance, then physiology, while the least possible place is given to hygiene. Now this is exactly wrong. It is not well or proper that young children should be instructed in the anatomy of their bodies. Perfect health, such as they should possess, should have no knowledge of organs. At the very best, what the average teacher can impart of anatomy to children is "that little knowledge which is a dangerous thing." Physiology is in a large degree a department of chemistry. Without a knowledge of that science no one can understand the ordinary changes of composition and decomposition; in a word, of metabolism within the body. Yet this is physiology, a science in no sense intended or adapted to the understandings of children.

Hygiene, on the contrary, can be understood by children; it can be understood in great part without any knowledge of anatomy, physiology, or chemistry. It can be not only understood but also applied by them. It would seem, then, to be common sense to place in the hands of children books which contain a minimum of anatomy and physiology, and a maximum of hygiene.

But still other weaknesses exist in the books in use in the schools of most of the American states. Recently laws have been enacted requiring a considerable portion of all school books on physiology to treat of the effects of alcohol and tobacco on the body. The demands made upon school trustees by the self-appointed agents who watch the enforcement of these laws, has been to drive from the schools nearly all the books written by educated medical men. This leaves in the schools books prepared for sale by untrained men and full of statements of an unreliable character, and calculated to bring the science into disrepute. These are strong statements, but it is only necessary to look into the books to prove them. It will be found that many unsolved problems are discussed as though fully explained. This is largely true in reference to problems in nutrition of the body. Looseness and inaccuracy of statement also prevail to an alarming degree, and to the injury of the pupils. Thus we read in one book of chloral hydrate, a dangerons drug in unskilled hands: "Taken in proper quantities it is entirely safe, and is exceedingly pleasant in its influence."

One of these books several times makes the positive assertion that tobacco produces cancer in its users. Another volume asserts that consumption may be caused by putting on spring clothing too early in the season. One also reads that cider drinkers are peculiarly crabbed and

cross, that tobacco makes old men illnatured, that sour milk is unwholesome, cheese is indigestible, *pork is a meat not fit to eat;* and bile has the properties of baking soda! Here is a fish story told in the words of a highly commended book,—"The Esquimaux who live in Greenland drink one or two quarts of oil and eat several candles every day." But see how a story will grow even in a scientific text-book. In the next number of the "series" written by the same author, and from the same reliable notes, doubtless, we read,—"An Esquimaux consumes about twenty pounds of blubber fat daily, besides drinking several quarts of train oil." What it will be in the next volume, who can tell?

As to the style and accuracy of these "scientific" treatises, the following may be taken as samples: "The eyeball is a bag (?) almost round, thick and dull everywhere but in front, where it has a transparent covering called the cornea, meaning the horn. This is fitted into the eye just as a watch-crystal is fitted into a watch." How lucid and true! Now proceed,—"The back chamber" (of the eye) "also holds a jelly-like fluid called the 'glassy humor,' which allows the iris curtain to float and move freely." Who does n't understand that much at least?

Another matter in connection with these physiologies should receive attention. Many of them contain a statement, printed in a prominent manner in the first portion of the book, that they contain "*a full and fair treatment of the nature and effects of alcoholic drinks and other narcotics in connection with relative physiology and hygiene.*" When the books are examined, however, "the full and fair treatment" dwindles into statements true and imaginary, of injurious effects of alcohol on the body. There is no effort at all made to discuss the different effects of large and small doses, of the effects on a full and on an empty stomach, of individual idiosyncrasies, and not a word of the beneficial effects of narcotics and alcohol when properly used. There can be no doubt but this unfair, unscientific, and untruthful manner of presenting this subject is having an effect, exactly the reverse of that which is intended. Children will soon find out that they have been deceived, and the result will be worse than if nothing at all had been said on the subject.

The strictures here noted apply to the books used in the public schools, and to a limited extent to those used in academies and colleges.

To remedy the condition of affairs here shown it is suggested:

1. That teachers of hygiene should make special preparation for their work. In the public schools, this preparation should correspond in amount and in quality to that required to teach arithmetic and grammar, while for teachers in academies, normal schools, and colleges, such preparation is needed as belongs to the strictly professional man. For the present the preparation of the teachers should be supplemented by work on hygiene and sanitary science in the summer schools, but eventually all teachers of hygiene in the higher schools should be physicians. In the public schools lectures on hygiene might now very profitably be given by local physicians.

2. For a graded series of text-books to consist of three books, it is recommended that

No. 1. THE CHILD'S BOOK OF HEALTH should treat only of elements of personal hygiene to which young children can give attention. The following topics would be suitable for such a book:

1. Work and Play.
2. The Food We Eat.
3. The Water We Drink.
4. The Air We Breathe.
5. The Sunlight We Love.
6. Rest and Sleep.
7. The Bodies We Cherish.
8. The Clothing We Wear.
9. Our Eyes and Ears.
10. The Voices We Train.
11. The Homes in Which We Live.
12. The Poisons Men Drink.
13. The Narcotics Men Indulge in.
14. Good Health.
15. How We Live.

If the books on health, intended for children and now in the schools, are examined, it will be found they contain in the main injunctions to correct living, over which children have no control. They are told what to eat and drink, and what to avoid, and what to wear, that they should ventilate their homes, open them to the sun, etc., etc., matters entirely beyond the control of children. This should all be avoided.

No. 2. ELEMENTS OF PHYSIOLOGY, in which the simple facts of animal and vegetable physiology should be taught, the illustrations being drawn from the animal and vegetable kingdoms and not from the human body.

No. 3. ELEMENTS OF HYGIENE AND SANITARY SCIENCE. This last book of the series should in the first part treat of all subjects of personal hygiene, as exercise, recreation, rest, food and drink, clothing, sleep, cleanliness, what to do in sickness and in emergencies, etc. The second part of the book should treat of the elements of sanitary science, a subject now wholly almost untaught in America in any schools below the medical colleges, but which should be introduced into all high schools, normal schools, academies, and colleges.

There is much important hygienic matter which should be imparted to children at a very tender age. This can only be done by their mothers or guardians. To prepare these persons for their work, it seems to the writer, a useful diversion might yearly be made by the university extension movement, and by teachers sent out by the churches and benevolent organizations. Probably the sowing of hygienic leaflets would produce good results along this line.

Bucknell University.

SOME POINTS IN THE HYGIENE OF THE YOUNG IN SCHOOLS.[1]

BY DR. J. CHALMERS CAMERON,

PROF. OF OBSTETRICS AND DISEASES OF CHILDREN, MCGILL COLLEGE, MONTREAL.

Some thirty years ago it was remarked, by Mr. Herbert Spencer, that the first requisite of success in life is *to be a good animal*, and that to be a nation of good animals is the first condition to national prosperity. As the nation is an aggregate of individuals, the history of the nation is in a certain sense the history of its individual units. Its strength, progress, and development depend upon the strength, progress, and development of its members; therefore, other things being equal, that nation will be most prosperous which secures the highest development for its members. From the age of four or five, up to fifteen or sixteen, the period of active growth and development, most children are at school, being educated and trained for their life work. If the schools fulfill their important functions well, and turn out their scholars *good animals* well equipped for the battle of life, the first condition of national prosperity will have been attained; but in whatever degree they fail to secure the best results, in the same degree they will hinder national progress. It seems, therefore, peculiarly fitting that the American Public Health Association should examine carefully the methods of the public schools, and inquire whether the best possible is being done, and whether sufficient attention is being paid to the all-important matter of hygiene.

However we may theorize as to the nature of man, we can at least distinguish two essential parts, *mind* and *body*; and however we may speculate as to their essence and mode of union, we know at least, that all life long they are linked together for weal or for woe—they develop together, mature together, decay together, ever dependent upon each other, reacting upon each other, sympathizing with each other, suffering with each other—when we strengthen the body, we invigorate the mind; when we starve and neglect the body, we starve and enfeeble the mind. It follows, therefore, that for the proper development of the individual, the body must be considered and cared for as well as the mind.

According to nature's plan, body and mind develop simultaneously, not alternately. While bone, muscle, nerve, and gland are growing and specializing, the child is busy observing, testing, comparing, gaining a knowledge of his environment, and learning to reason and think. So the process goes on; but by and by the child is sent to school. Is the same plan of development continued? Do our schoolboards realize that education should look to the physical as well as the mental needs of their scholars, and that strong bodies are as essential to success in life as well-

[1] Read at the Montreal meeting.

stored minds? When we look at the curriculums of our schools, we find no lack of studies; perhaps the courses are too extensive and too much is being attempted. We find that the scholars are carefully graded and arranged in various form and classes, that their work is thoroughly systematized and that they are taught and examined *secundum arbem*. All are cared for, none are overlooked. But in how many schools is adequate attention paid to the physique of the scholars? In how many is their physical condition examined and studied? Before they are promoted to a higher form, they must obtain a certain percentage of marks in their examination and demonstrate their ability to undertake more advanced work. But is there ever a question as to their physical condition, their physical ability for the new work? At the end of the year they are examined to determine their scholastic proficiency; is there ever a question as to how the body has fared meanwhile? Some schools have play-grounds and give a recess presumably for play; but play is optional —the children may play or not as they please—all together, the weak and the strong, junior and senior—there is no grading, no direction or supervision. Some schools have a gymnasium; but in how many is there a competent instructor to examine the scholars and grade or supervise their work? What sort of progress would there be in a school, if the scholars were allowed to choose whatever studies they pleased, go into whatever classes they pleased, and study or not as they pleased? And in like manner, what sort of bodily development can be expected when the arrangements for physical training are so crude and unsatisfactory? Of late years the hygienic condition of schools has greatly improved. The authorities are more careful about sanitation; more attention is paid to drainage, ventilation, and cubic air space. Health boards have done good work in this line, and the public have become more impressed with the necessity for good hygienic arrangements in public schools. But has the *personal hygiene* of the scholars received due attention? Is their physical culture being properly cared for? Are they being instructed in the principles of hygiene and taught how to care for their bodies and maintain them in health? I fear we must admit that in these respects, our educational system is sadly deficient.

In the case of the boys the consequent ill effects are less evident; play, out-door exercise, athletic sports, and gymnasia go far to supplement the deficiencies of the schools. But in the case of the girls, the matter is far different; as a rule they have less out-door exercise, are more inclined to be sedentary and consequently suffer more from want of attention to their physical development than boys. Spinal curvature and pelvic deformity in women, which are so common in Europe, have been comparatively rare in America; but as the country becomes more thickly populated, and the cities more densely packed, we note the rapid increase of these deformities. They are rarely congenital, but are for the most part developed by faulty hygiene during the process of growth. Childhood is the time to detect and prevent such deformities. At the sixth year, the car-

tilage in the acetabulum ossifies, and by the fifteenth or sixteenth year the three bones are completely united, and the lines of union disappear. During the eighth year, the vami of the pubes and ischium coalesce. If we compare the pelvis of the female infant at birth, with that of the fully developed adult, we find that the shape has entirely changed. The deep, square, flat-sided pelvis of the former with its long conjugate and shorter transverse like that of the lower animals, has given place to the shallow, curved, basin-like pelvis of the latter with its shortened conjugate and lengthened transverse diameter. This change is effected while the growing bones are ossifying, mainly by the action of three factors,—

1. The body-weight transmitted through the spinal column presses the sacral promontory downwards and forwards, the lower end of the sacrum being steadied by the sacro-sciatic ligaments the sacrum is curved, the conjugate narrowed, and the pelvis rendered shallower.

2. The sacrum being suspended like a transverse beam between the iliac bones, the body-weight transmitted to it through the spinal column puts the posterior sacro-iliac ligaments upon the stretch, tending to open the iliac bones like a flange. But as the anterior ends are fastened together at the symphyses, the result is a widening of the transverse and a still further narrowing of the conjugate.

3. Counterpressure applied to the acetabula through the femora opposes and modifies the action of the first two factors. Of course muscular action also plays an important part. The problem of pelvic development is therefore largely mechanical. If there is proper coördination of the various factors while growth and ossification are going on, a normal pelvis will be formed; but any interference with the factors will more or less vitiate the result. For example, if the body-weight is directed too much to one side, or in front, or behind, the whole shape of the pelvis may be changed. The ill effects of spinal curvature are thus evident. Or if the child is sitting most of the time, the counter-pressure of the femora is not wholly effective. Most girls are at school during the period of most active pelvic development; if they are allowed to sit too long, or in faulty positions, their spines may curve, the body-weight be transmitted in a faulty direction and deformity result. It is of the utmost importance, therefore, that school children (particularly girls) should be taught to stand, sit, and walk properly. When faulty habits of position have been acquired, they should be corrected. It is also important to recognize the beginnings of deformity, in order that proper and timely treatment may be instituted.

Not only should children be taught in school how to stand, sit, and walk, but, more important still, they should be taught how to breathe. The capacity for exertion depends in great measure upon respiratory capacity. The lungs and heart completely fill the thorax; whatever increases its capacity will increase the amount of air in the lungs. The venous blood coming from the tissues laden with CO_2 is spread out in the capillaries, the air plays over the little lakes of blood and an inter-

change of gases takes place; CO_2 is given off and O taken in. The blood thus renovated and vitalized returns to the tissues. Tissue-life implies the constant consumption of O and discharge of CO_2. The tissues are constantly craving life-giving O; the more O they receive and CO_2 they discharge, the fresher and more active will they be. The functional activity of all tissues and organs depends upon the activity of the respiration and circulation; if the best work is to be done, these functions must be active.

C. in. 30=*Tidal* air—which passes in and out during ordinary quiet breathing.

" 220= { *Reserve* 100—for heavy work.
Residual 120—which cannot be expelled.

———

" 250=Air in lungs at the end of an ordinary inspiration.

" 100=*Complemental*—may be voluntarily inhaled by a forced inspiration, in addition to the *Tidal*.

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" 350=Total capacity of the chest.

If we can increase the chest capacity and the amount of tidal air, the tissues will be better fed and do better work. The great object of physical culture in schools should be, not the formation of muscle and development of athletes, but the securing of a good respiration and circulation, in other words, teaching the scholar how to breathe. In after life the great need of men and women is not so much muscle as chest capacity. Circulatory and respiratory power often turn the balance in disease or accident. Every cubic inch added to lung capacity is an addition to the length of days and to the amount and quality of possible work. How much has been lost to the world by the physical weakness and imperfection of its great men—the cultured brain limited, hampered, marred by physical infirmity—the body a hindrance instead of a help?

Quite recently an interesting series of investigations has been made by Dr. Gulick of Springfield upon the sphymographic tracings of long distance runners, and it has been shown that their staying power is due to their great respiratory power. The greater the chest capacity and the fuller and deeper the respiration, the less rapidly does the heart need to beat, and the less wear and tear will there be on heart and blood vessels. Increased chest capacity and respiratory power mean, therefore, either increased work, or decreased wear and tear of the machinery.

Let us consider now some of the practical deductions from my theme, which may fairly claim the attention of this association. What can be done to improve the personal hygiene of the young in schools?

In general terms, it is fair to maintain that in the education of the young, mind and body should not be divorced, and that suitable provision should be made in our school system for the simultaneous training and

development of both. As the body matures first, it is important to pay special attention to bodily development ere it is too late, *i. e.*, in the plastic period of growth. For young children, the kindergarten system, which approaches education from the physical side, is the ideal plan; and even for the lower forms of the public schools similar methods may be employed with advantage. Just as the child begins its studies by mastering its A, B, C, so in physical culture it should begin with fundamentals, and learn how to sit, stand, walk, and breathe. Then come the simpler calisthenic exercises, marching and gymnastic games. Drill and grading gymnastics are added according to progress and requirements. In high schools and colleges a careful examination should be made from time to time, of the physical condition of the pupils, and such courses of exercise prescribed as are suitable for their special needs. In the larger American colleges this matter is now receiving great attention. Professors of physical culture have been appointed to look after the physical development of the students, and instruct them in the principles of hygiene. In McGill, Dr. McKenzie, one of our demonstrators of anatomy in the medical faculty, is the university instructor in physical culture and superintendent of the gymnasium. He has the double gratification of being a thoroughly trained physician as well as an expert gymnast. The system he has devised for McGill is simple and efficient, and meets all practical requirements. No student is permitted to engage in gymnastic or athletic work till he has been examined by Dr. McKenzie, and obtained a certificate of his physical fitness. At present this examination is not compulsory for those who do not wish to avail themselves of the opportunities offered for physical culture, but we hope ere long to have the system extended, so that every student in the university will come under its regulations.

Hygiene should be one of the subjects of study in schools. The pupils should be taught something of the mechanism of their bodies, for how can they be expected to take proper care of a machine of whose structure they know nothing? In high schools and colleges, a series of lectures and practical talks upon the structure, functions, and care of the body, would be of great value. In order that such a system as I have briefly outlined may be efficiently carried out, it is essential that all those who are being trained for the teaching profession should be carefully instructed in hygiene and physical culture, and impressed with their great importance. Teachers should feel it to be their duty not only to instruct their scholars so that they may be promoted at the end of the year, but to make them vigorous and healthy at the same time. There are periodical examinations as to scholastic attainments, why should there not also be examinations as to physical development? In the larger cities a valuable addition to the educational staff would be an inspector of physical culture, preferably a medical man, who should visit the schools from time to time and inspect the progress of the pupils. To him could be referred any doubtful cases in which spinal curvature or any other physical infirmity is

suspected—where, for example, a child is stooped or finds it difficult or painful to sit or stand straight or join in the general exercises and sports. Youth is the time and school is the place for the detection and cure of irregularities whether physical or mental.

It has often struck me that school desks are responsible for a good deal of deformity. In ancient times it is said that Procrustes had an iron bed on which he used to stretch his captives. If they were too long he cut off their legs, if too short he stretched them till he made them fit his bed. In our schools we have iron desks and seats of uniform height, and scholars of all sizes. The desk can not be altered, so the scholars must be made to fit the desks. If too tall, they must bend and stoop; if too short, they must reach up somehow. No matter whether the spine is curved, the shoulder raised, the chest compressed. Could there not be some simple arrangement of raising and lowering desks and seats like a piano stool so that the proper height might be secured for each pupil?

What shall be the general type of exercise in schools? Of course great latitude must be allowed. Perhaps the bar-bell exercise is most generally applicable. It is cheap, safe, easily learned, capable of wide modification and adaptation; it works one set of muscles against another and is therefore less liable to strain or injure the feebler shoulders. In any case, whatever form of exercise is chosen, attention should be directed chiefly to the development of the extensors. It is a curious fact that civilization tends to develop the flexor muscles at the expense of the extensors. Observe the attitude of children in schools, of men and women sitting in church or public meetings; watch them walking or standing on the streets, or driving in carriages. The rounded shoulders, stooped figures, bent limbs, the general tendency to double up, prove the relative weakness of the extensors. Physical exercise in schools should aim to correct this tendency and cultivate the habit of sitting, standing, walking, and breathing properly. A child that sits improperly, is apt to stand and walk improperly; if the bad habit is not corrected, more or less permanent spinal curvature is apt to result. As most children are right handed, they are apt to sit at their desks with the left shoulder raised; if school hours are long, and the faulty sitting position becomes habitual, they will naturally bend to stand mostly on the right leg. Walking and athletics may not suffice to straighten out the curvature which in after life becomes more pronounced in those who sit most of their time at office desks. Tailors and dressmakers tell us how common it is for the left shoulder to be higher than the right, so much so that they have to pad up the right in order to restore an appearance of symmetry to the figure.

As a public health association we can do much both individually and collectively to form a sound public opinion respecting these important matters. As long as parents grumble that their children go to school to learn their lessons and not to learn to play, school-boards will be hampered in their efforts to secure better physical training for the young. But as soon as parents recognize the importance of these matters, and

demand a modification of the school system, the boards will soon fall into line. Laws and regulations are of little use, unless backed up by public opinion. Surely this is an important line of work for this association. Much has been done in the way of improving the ventilation, drainage, and general sanitary arrangements of schools. Can we not go a step farther and try to improve the personal hygiene of the scholars? Much has been done in investigating the causes of disease and preventing the spread of infection. Can we not go a step farther and develop in children strong bodies which will resist the inroads of disease? Bacteriology has taught us that many diseases are directly traceable to the action of microbes introduced into the body from without. The seed, the infective microbe, is one factor; the suitable soil, the debilitated body, is the other factor. Dazzled by the brilliant discoveries of bacteriology, have we not overlooked somewhat the necessity of rendering the soil unsuitable for the growth of the seed by developing the resisting powers of the human body? If we attack the problem from both sides, its solution will be easier and more satisfactory.

We live in an age of restless activity; now more than ever is there need for strong physical frames to bear up in the ever increasing struggle of life. Now more than ever are men and women breaking down in middle life, their usefulness cut short when they have become most valuable to society and the state. Now more than ever is the battle to the strong, and staying power is essential. We have a goodly heritage from the past, a glorious prospect in the future. If we would transmit that heritage to posterity unimpaired and realize the great possibilities which lie before us, we must see that in the education of the young we do not divorce mind from body, but assign to each its proper place. Thus, and thus only, can we secure to posterity that most desirable of earthly blessings, the "*mens sana in corpore sano*," the sound mind in the healthy body.

NECESIDAD DE ENSEÑAR LA HIGIENE EN LAS ESCUELAS DE INSTRUCCION PRIMARIA POR EL MÉTODO OBJETIVO.

Por el Dr. JESUS E. MONJARÁS, San Luis Potosi, Méx.

La enseñanza de la ciencia que tiene por objeto, directa ó indirectamente, la conservación del individuo; que impide la alteración de su salud y le prepara á formar familias y sociedades dotadas de vigor físico y de energía moral;—en una palabra, el conocimiento de los principios y de las leyes de la higiene es de una importancia capital, y por lo mismo el estudio de sus primeros rudimentos debe formar parte de la educación de la niñez, sin lo cual el progreso de esa ciencia no avanzará sino lentamente privando á la humanidad de sus benéficos efectos.

Puesto que debido al desarroyo actual de la civilización el sentimento del bienestar tiende á ocupar el primer rango en nuestra vida, los medios de instrucción necesarios para obtenerlo, deben ser conocidos lo mas temprano posible para hacer mas eficaz la fuerza activa que se despliega en la educación.

Así, los elementos de instrucción que conciernen á la conservación del individuos, los que tengan por objeto mejorar las espécie, serán los que el hombre deba asimilar de preferencia. Es evidente que si ignoramos las acciones y las precauciones con ayuda de las cuales podemos asegurar incesantemente nuestra conservación, llegaremos con una aptitud insuficiente á la época en que necesitemos emplear nuestra actividad física, no solo para nuestro bien personal sino para ayudar con nuestros propios elementos al desarrollo sano y perfecto de nuestras familias y por consiguiente de la sociedad en que vivimos.

Obrar de esta manera es continuar en el camino que la naturaleza mismo nos impone cuando somos incapaces de dirigir nosotros solos nuestras acciones, dotándonos del instinto necesario para huir de aquellos seres ú objetos desconocidos. Mas grandes las funciones fisiológicas nos advierten incesantemente qué grado de fuerza es presiso gastar sin perjuicio, ya en nuestra instrucción, ya en nuestras ocupaciones, etc.

Pero no basta evitar los fenoménos que pueden comprometer nuestra vida ó nuestra salud de una manera evidente, es preciso saber prevenir lo mas temprano posible, los mil daños insidiosos, invisibles, que dañan nuestra existencia y preparan nuestra receptividad á los agentes de enfermedades agudas ó crónicas que empobrecen ó destruyen nuestro organismo. La higiene nos proporciona medios eficaces para evitar estos daños, y por esto es que en los paises civilizados el poder público

dicta medidos que garanticen nuestra existencia conta los peligros quer las colectividades de seres vivientes desarrollan.

Y sin embargo estas medidas encuentran no pocas veces, no solo indiferencia, sina aún oposición para ser puestas en práctica, aún entre personas mas ó ménos iniciadas en las ciencias médicas y dotadas de cierta instrucción científica en general. Es preciso, pues, dar á conocer sus ventajas, hacer palpables sus beneficios, porque las leyes para que sean eficaces, necesitan ser comprendidas y apreciadas por aquellos para quienes se han dictado.

Para penetrar el espíritu de las leyes ó de los reglamentos que se refieren á la higiene, no basta el sentido común ni nociones abstractas, es preciso una instrucción sólida, basada en el conocimiento de los principios en que descansan los ramos de aquella ciencia, obtenidos por el estudio *objectivo* de los lugares, aparatos y demas particulares que se refieren á esta materia.

Á este fin tienden las conferencias populares de higiene social instituidas con tanto acierto en París por el sabio higienista J. A. Martin, las que Mr. Jensens ha organizado en Bruselas y las que se practican en Allemania, Inglaterra, etc. Pero ellas no bastan: son aún insuficientes porque es reducido el grupo social que asiste á ellas, y porque siendo adultos ó ancianos y ocupados ya en tareas productivas, asimilan pocos conocimientos sobre la materia y dedican poco tiempo á su estudio, extendiéndose la expanción de estos conocimientos á una esfera relativamente reducida.

La enseñanza de estos principios debe procurarse á todos los habitantes de una localidad, debe extenderse pues á la escuela de primeras letras para que los niños se habituen á estos asuntos; y no con definiciones ó verdades generales que rara vez comprenden y que olvidan cuando otra impresión mas profunda se fija en su cerebro, sino empleando el método de intuisión, sometiendo al exámen directo de los órganos de los sentidos instrumentos, aparatos, y aún juguetes que sinteticen lòs principios de la higiene social. Por ejemplo, cuando se enseñe la desinfección se les mostrará una estufa de desinfección funcionando, y en seguida se pondrá á su disposición pequeños modelos de carton, madera ó fierro desarmables para que los niños en su natural deseo de analizar se dén perfecta cuenta de la importancia del asunto. Lo mismo se hará al enseñar la cremación, el alejamiento de las inmundicias, la ventilación, etc.

Las ideas que por esta clase de impresiones desarrolla la percepción en los niños, se fijan casi para siempre en su memoria y les permiten mas rapidamente penetrar á la esfera de las ideas abstractas y poder caminar en ella con gran firmeza. Los conocimientos que adquiere el niño por medio de los sentidos, los recoge, conserva y mas tarde los generaliza, clasifica, ayudando al entendimiento á observar, analizar, sintetizar, abstraer, comparar, y generalizar. Las aplicaciones prácticas y generales que hace de estos conocimientos, constituyen una cos-

tumbre en su vida que sin esfuerzo intelectual les permite obrar en lo sucesivo.

Este método (método intuitivo) que consiste como lo dice Homer, en sometcr los objetos al exámen directo de los órganos de los sentidos para deducir de esta observación ciertos conocimientos y desarrollar por medio de ella las facultades intelectuales y morales de los niños, puede aplicarse á la enseñanza de los principios elementales de la higiene, empleando en las lecciones siempre que sea posible, aparatos, instrumentos ó instalaciones funcionando en la actualidad; así como experiencias fisiológicas, qnimicas y físicas. Cuando esto no sea posible, la linterna de proyección prestará ayuda muy eficaz y á la vez económica, pues los progresos que los fabricantes han introducido en este interesante aparato y el empleo del movimiento en las vistas permite desarrollar en la enseñanza de la higiene procedimientos por complicados que sean, que producen los resultados mas sorprendentes por su claridad y fuerza demostrativa.

Todas las materias que abraza la higiene pueden ser enseñadas siguiendo este método; pero se dará la preferencia á los siguientes:

1. El aire.—Cuerpos que contiene en suspensión.

2. El agua.—Las diversas aguas potables: agua de manantial; agua de rio; agua de pozo; medios de purificar agua potable; filtración, ebullición.

3. El suelo.—Termalidad; agua telúrica; red de agua subterranea; pantanos; saneamiento del suelo, drainage.

4. Habitación.—Materiales de construcción. Distribución de las piezas; su orientación. Cubo de aire necesario; vcntilación, alumbrado, calefacción. La casa insalubre: la casa salubre.

5. Alejamiento de las inmundicias; sistema de W. C.—Enfermedades producidas por los desechos humanos.

6. Limpieza personal.—Baños y lavaderos baratos; hidroterapia; lavado de la boca y fosas nasales.

7. Alimentación.—Substancias alimenticias, descompuestas, falsificaciones.

8. Ejercicio y gimnasia.

9. Edificios escolares.—Mobiliario, material de instrucción.

10. Enfermedades transmisibles.

11. Inhumación, cremación.

12. Vacuna.—Enseñar los institutos donde se cultiva el virus vacuno en terneras y niños.

13. Desinfección.

14. Establos. Lecherias.

15. Principios de física aplicada á la higiene.

16. Bactereologia elemental.

17. Climatología: enseñar los aparatos que en ella se usan, etc.

A FEW REMARKS ON SCHOOL HYGIENE[1].

By M. T. BRENNAN, M. D.,

Prof. Hygiene Jacques Cartier Normal School, Commissioner for City of Montreal, etc.

The facts I wish to present to this important and learned association are not all new, nevertheless, I believe they are worth being repeated; they will be reinforced by reconsideration and the addition of new ideas. The subject of School Hygiene demands the knowledge and support of distinguished sanitarians, such as those who compose this honorable assembly; so, attention will be brought to bear on it from the right quarters.

As connected with school matters, and especially the education of children, hygiene is, I may say, still in its infancy in many localities. In many places it is perhaps even embryonic and may have to grow up with the coming generation before it obtains a firm and permanent foothold.

It is urgent that our children should be assured every possible way of maintaining their health, and of bettering it, if possible; in all parts means do not seem available—often through ignorance—so the poor children suffer. Should such matters not be looked into, or no efforts made to ameliorate many sad conditions? We, as mankind, may in a few generations more be nearly extinct as regards health, and become merely walking columns of microbes—a conglomerate of all the actually known schizomycetes and of a host of others newly "hatched" or "spored" by cross-breeding. What fun they will have with our cells. The only way to avoid such a perambulating microbic stage is to surround the child with all the protection available,—make him strong for the combat.

I shall consider but a few facts, and those somewhat superficially, time and place not permitting or necessitating a thorough study of the question.

We may take up successively (1.) The teaching of hygiene to children. (2.) The knowledge required by teachers and those entrusted with the care of children. (3.) The influence of the family physician and of the school physician. (4.) General hygienic supervision.

The *first* consideration we will pass over lightly, simply insisting that the satisfactory teaching of hygiene be obligatory in all schools where its principles can be understood; and that it be taught in a practical, interesting, and convincing manner. The details of the methods to be employed belong to the art of teaching, and should receive the utmost attention and study from teachers. It is a subject I shall treat elsewhere and at another time; however, there is one point to be remembered and

1 Presented at the Montreal meeting.

that is that the child must, while yet young, be made to understand the necessity of hygienic knowledge and of compliance with its requirements: moreover, he must see its principles put into practice by those around him.

Under the *second* heading may be grouped many important and interesting topics.

All persons having charge of the rearing of children, parents, tutors, clergymen, priests, friars, nuns, lay teachers, and others, should have a sound knowledge of hygiene; unluckily, such is far from being the case in many places. The only knowledge many teachers possess is that contained in a little manual with questions and answers, dry and unproductive of learning, which they condemn their pupils to learn off by rote. This is worse than nothing, disgusting the child with an interesting and vital subject which can be made so agreeable and useful when taught by one who understands it, and knows how to impart it.

The way to approach parents and the general public would be by means of interesting books and pamphlets on hygienic subjects, insuring a wide distribution of such works; they should not be an arid digest of laws, but readings that please and convince, and wake up the reader to the importance of the subject. This method combined with the intelligent support of physicians and spiritual advisers would soon ease the work of boards of health. The public must be educated, for it is very discouraging for the child who is taught hygiene at school, to hear its truths scoffed at at home by parents, and sometimes, alas! even by unworthy professional men. Thus erroneous and disastrous ideas are substituted for the wholesome learning the child was absorbing. Let the public, then, be educated by all means at hand.

It is imperious that clergymen, friars, and nuns should attend a course of lectures on hygiene given by a competent specialist. Such has not been done so far, but it is time that the necessary instruction be demanded, as the ignorance of it is very detrimental not only to the advancement of school hygiene, but to the progress of public sanitation.

Nuns and female teachers in boarding schools should especially be forced to understand the importance of such knowledge; so that they may draw the immediate attention of a parent or an hygienist to anything faulty.

It is a fact that the entombing, so to say, of children in convents and colleges, overcrowded and often without any efficient hygienic supervision, is deplorable. I do not wish to insinuate that all scholastic institutions are unhealthy, for certainly they are becoming more inhabitable, and things are better than formerly; but I affirm that there are great things left for hygiene to do; even in some of the best institutions I have seen girls contract grievous ailments from which they could have been protected by timely warning and proper care. It is often thus that puny, tuberculous, or anæmic women are formed, who marry and rear children, one or several degrees more sickly and delicate than themselves.

Among other important things menstruation and puberty, the action of the kidneys and bowels, should be looked into. No false modesty should here arise and deprive the ignorant girl of her right to protection. This chapter of hygiene for teachers should be carefully, thoroughly, and straightforwardly dealt with, so as to be well understood and justly appreciated by those entrusted with the care of girls. In this way the parents or the physician may receive timely notice of any irregularity.

The question of punishments and physical training should be well known, so as to avoid injury or ill treatment. Some foolish, useless, often dangerous practices might be discarded. A custom once prevailed of obliging offenders, for slight offences, to topple over, some artistically, others awkwardly, and imprint an unaffectionate kiss on an always insensible and often microbe-swarming floor. How many of those who went down microbe-free, but arose with a load of famishing microscopic imps, ready to invade their system? Who knows what terrible battles the phagocytes must have delivered against those fearful marauders?

Each punishment should receive serious study from a moral and from a hygienic standpoint.

The tobacco and alcoholic habits should be strikingly dealt with, their pernicious consequences brought out, this both in girls as well as in boys' schools. In women, the habit of tippling is far more prevalent and disastrous than is imagined. Within the last four months I have seen four women, each a mother of several children and moving in good society, die from the effects of chronic alcoholism.

Those terrible habits can be eradicated only by instructing the child fully as to their awful consequences.

How many other subjects might I not draw attention to, which teachers should fully comprehend and know how to impart, but these will suffice to show the necessity of the teacher's possessing the requisite knowledge.

Teachers, in a certain measure, should be familiar with the symptoms of the incipient stage of certain disorders, contagious diseases, phthisis, certain nervous troubles, eye diseases, joint affections, etc., that they may warn the physician early of any suspicious symptoms.

They should be convinced, by thorough training, of the urgency of minutely following the advice of the school physician, or the "pointers" given by the family doctor.

No diploma should be awarded any teacher, male or female, layman or religious, who is not proficient in school hygiene. The principals of schools should be "up to date," and the humble country teacher should possess the knowledge to convince the pupils, the parents, and the school board, of the necessity of practical hygiene being carried out, not only in the school, but throughout the locality. With learning and tact the teacher will become a valuable helper in the diffusion of wholesome doctrines and practices. With such help and that of the clergyman or priest, the work of the board of health would be smoother, more successful, and find favor.

I would here humbly suggest that in order to give more advantages to school hygiene, a special committee be this year formed in this influential body, the American Public Health Association, to look after the interests of school hygiene and the hygienic education of children.

The authoritative decisions of such a committee would do so much to assist the cause of this important section of public hygiene.

I will now take up the *third* point: the influence of the family physician and that of the school physician.

I would utter an earnest appeal for the family physician's being better looked upon by school authorities in general; as a rule, no one knows the constitution and peculiarities of a child better than does the family attendant. I should like to see almost every child who enters a boarding school, or even a day school, provided with a certificate from the family doctor setting forth the weak points in the child's nature. Much good might thus be done, and harm often avoided. There should be judicious inflections in the rigid rule that submits a hundred or more of children of widely different constitutions and degrees of health to the same conditions of seclusion, exercise, study, food, punishment, etc. The moral and physical capacities of a child are not always equal; and again, among different children, from one to another there is a wide difference. The poor, humble, abused family doctor might often suggest and be listened to with profit. This harmonious coöperation can not be obtained if the teacher, or principal, or superior, does not possess sufficient hygienic knowledge to understand and fully appreciate the "danger signal" or the "pointer" put forward by the family physician. Timely advice may save a hip joint, a knee joint, a womb, a heart, or a lung.

The position of medical attendant to a school is not always what it should be. I may say the same of that of our large convents where so many useful lives are entombed. The physician is called in for sickness only. I think it should be the especial duty of that person to prevent sickness by attentive hygienic supervision of the pupils themselves and their surroundings. Where there is no director of physical culture,—but there should be one in all schools,—the school physician should see to the physical aptitudes and morbid tendencies of each child. There are few parents stingy enough, who in order to assure the safety of their children, would refuse to give a few dollars extra to pay the medical attendant reasonably for the attentive performance of his duties. It sometimes occurs that the physician has not sufficient power to act with effect; I have known of cases where the isolation and treatment of certain communicable diseases were deemed unnecessary by certain authorities notwithstanding the physician's affirmation. I assert that the attending physician should receive more support and protection from sanitary bodies.

I have a last point to consider: general supervision. As there is a superintendent of public instruction, so, I claim, there should be some kind of a superintendent or inspector of school hygiene, a man whose duty

would consist in seeing that the laws of hygiene are taught and practiced in every educational institution, and without whose consent nothing important relative to school hygiene should be undertaken. There should be uniform systems of ventilation, lighting, construction, etc., approved of by the boards of health and health associations, which he should see were put into execution. This position of school inspector should be somewhat independent of the ordinary public boards, and confided to an able man, not only well up in ordinary sanitation, but also possessing an intimate knowledge of the art of teaching and its requirements.

Till localities could afford to nominate such a special independent inspector, the local and general boards should be paid a little extra to look more attentively into the matter, they should be more familiar and more in direct relation with the working of the educational system.

To sum up briefly, ladies and gentlemen :

First, the general public must be aroused to the urgency of school hygiene and the hygienic education of children; the public must also be gradually instructed in hygienics.

Second, hygiene must be well taught to school children.

Third, teachers, superiors, and others engaged in teaching must be proficient in hygiene.

Fourth, in each school there should be a school physician endowed with power to act. The family physician should be consulted.

Fifth, there should be some system of efficient general supervision.

Sixth, the support and co-operation of local and general boards of health and of the board of public instruction should be assured.

The cost of such a system might, I think, be pretty easily surmounted. The literature published for general circulation might be nearly paid for by advertisements relative to sanitary science accompanying it. Each institution could pay its own school physician; in public day schools the commissioners should be called upon to lend a helping hand. A government grant might be obtained for the inspectorship.

The suggestions I have brought forward in this paper are simply general; I perceive the difficulties to be surmounted, but there must be a beginning. It is that beginning I would wish to see established in all sections; the details of the question belong elsewhere to a special commission. I simply wish to draw the attention of the association to the fact that school hygiene requires to be given more notice, and that means should be taken to insure its introduction into all localities. The children of to-day are the men and women of tomorrow. Let every one begin to-day, and tomorrow there will be less to learn and all will be ready to assist hygiene in making long strides toward a presidential seat overlooking all other learning. Let the child grow up surrounded by its truths, let him practise its laws when grown up, let him teach them to his children, and when he leaves for the "happy hunting grounds" let those be hygienic to receive him, so that he may not infect his survivors; if not, let him burn—be cremated!

Ladies and gentlemen, I must close a paper far too lengthy and too monotonous, which I pray you to excuse and deal indulgently with.

If I have scattered a few "tacks" I hope some interested parties will step on them and "wake up"; I moreover hope that this Association by its honored support and knowledge will cause the public, and more especially those engaged in education, to reflect on the subject of school hygiene and see the necessity for more earnest work and serious reform, thus insuring in the near future better knowledge and compliance with the laws of hygiene throughout the land.

DISCUSSION.

DR. H. R. HOPKINS, of New York:

Mr. Chairman: This subject is one of exceeding practical interest, and I have listened to the papers of the various readers with great satisfaction. There are, however, in the matter certain practical suggestions in the way of difficulties which none of the papers, so far as I can recall, dwelt upon. It occurs to me that possibly some of the speakers in the discussion may throw light upon this subject. I will briefly narrate some of the difficulties that have arisen in my own mind in attempting to grapple with this subject after having given it some attention for a number of years. We are told from these papers that hygiene must be generally taught in our public schools. This assemblage of pupils includes girls and boys. We hear phrases habitually dropped from the lips of the readers themselves that knowledge must be imparted without reference to false modesty. Gentlemen, right under that point is a tack. It is a tender thing to step upon. I know of no practical way of teaching hygiene without teaching physiology, and I conceive it to be impossible to impart to human beings that knowledge of themselves which will give anything like a grasp of hygiene without teaching them the functions of all the component parts of their body. I wish some of the speakers who have given this matter thought will tell us how they can teach physiology to growing girls. How can they teach them the functions of the various parts of the human body so that they thoroughly understand them and still leave them their modesty? That is the practical question that has puzzled me for years. I wish some of the speakers would tell us just how they will teach the physiology of sex, the physiology of reproduction and physiology generally, and leave to the young girl of thirteen, fifteen, or sixteen years of age her modesty. There is another practical point in the matter of school hygiene which in the states certainly is of great importance. The trend of school life is to shorten the hours of study and to increase friction and tension, to focus upon three or four hours of school work the entire work of the day. It occurs to me to be physiologically impossible to have the work of eight hours done under the strain and stress of three or four hours, and have the anatomy and physiology of our students at the end of the school year where it should be. How this can be obviated, it occurs to me, is a question that this Association can very well express itself to the benefit of the American public whose health we direct.

Dr. T. M. Brennan, of Montreal:

I would say in reply to the last speaker that the subject of physiology is especially reserved to be taught to teachers having the care of children, and not to the children themselves, such as women teachers having charge of female schools.

VENTILATION OF SCHOOL-HOUSES.[1]

By J. E. DORÉ, Sanitary Engineer, Montreal.

Whilst the necessity of having efficient means of ventilation in a building in which a large number of human beings remain for any length of time is no longer questioned, there are still great differences of opinion both as to the best manner of securing the required fresh air and as to the quantity of it which it is necessary to obtain.

It will not be necessary here to dwell upon the importance of ventilation in buildings devoted to educational purposes. Let it suffice to quote the following words of Dr. Hiller, the learned secretary of the Metropolitan Medical Association of London. Speaking from a wide experience, this gentleman says:

"School rooms are never provided with due means of ventilation, by which a constant supply of pure air may be maintained; and the inattention, dullness, and sleepiness of pupils are but the natural and inevitable consequences of taking into the system a vitiated and poisonous atmosphere. The occupation of such rooms being the lot of the larger portion of the rising generation, who can wonder that our race is degenerating in physical powers? Who can doubt that such a state of things prepares the soil and sows the seed which in due time spring up into that luxuriant harvest of ailments and complaints which is reaped by the victims of our school rooms?

"In consequence of the ill construction and bad ventilation of the schoolhouses in and about London, seven thousand children between the ages of five and fifteen years continually lose their lives from these causes alone."

It is generally admitted that the requirements of ventilation increase in opposite ratio to the age of the pupils. Numerous experiments have proved that an atmosphere which is still fit for adults can be a cause of serious uneasiness to children.

Too much care, therefore, cannot be taken in preparing the hygienic conditions of schoolhouses.

The object of ventilation being to supply to each individual a given quantity of air of a given degree of purity, all good systems of ventilation must

First, determine the circulation of a definite and adequate volume of air.

Second, bring this volume of air to each individual as free as possible from admixture with the vitiated atmosphere.

The importance of this last condition can be readily understood when the laws of respiration are considered. A man inhales a volume of 0.017 or 0.018 cubic feet into his lungs with every breath. The average number

[1] Presented at the Montreal meeting.

of aspirations being from 16 to 18 per minute or from 960 to 1080 per hour, it will be seen that about 18 cubic feet of air is consumed by each individual during that length of time.

If consequently it were possible to completely separate the pure from the vitiated atmosphere, it would be sufficient to supply him with this small volume of fresh air.

The absolute separation of the pure and vitiated atmosphere is not possible; but it is not less important, for that, to reach as near this result as possible.

By a careful study of all the elements connected with the question, with that end in view, it will be possible to largely reduce the quantity of air to be introduced, and hence, to reduce in the same proportion the cost of the motive power and of heating the fresh air introduced.

Under such cold climates as ours is, this last item is a very important one.

What, then, is the necessary quantity of fresh air?

How should the flues be arranged?

Those are the two great questions; but from what has been said above, it is apparent that the solution of the first largely depends upon the answer given to the second.

This fact contains the explanation of the wide differences of opinion which exist between those who have sought to determine the necessary quantity of fresh air.

We shall therefore proceed to define what seems to us to be the most reasonable arrangement of the flues. In doing so we find ourselves in the presence of two schools of sanitarians. The one, starting from the fact that carbonic acid is denser than the atmosphere, would place the inlets near the ceilings and the outlets near the floors. The others, on the contrary, would bring in the fresh air through the bottom of the room and draw out the vitiated atmosphere through the top.

We are disposed to take side with the latter on the following grounds:

Although carbonic acid is really denser than atmosphere, when this gas leaves our lungs it is mixed with a certain quantity of water vapor. Moreover, the temperature of this mixture being ninety-eight and a half, it is much higher than that of the circulating atmosphere, which should always be about sixty-five degrees to ensure healthy conditions in the school room and the result is a rising current which carries the vitiated atmosphere upwards.

Carbonic acid is not the only element which contributes to render the atmosphere unbreathable. The organic matters which come from breathing and transpiring also are very dangerous. Beclard, a well known French author, has noted a certain number of cases in which persons having been rescued from asphyxia, after a prolonged stay in insufficiently ventilated places, were attacked by diseases which are not found on those who are brought back to life after asphyxia from carbonic acid produced directly by the combustion of coal.

Another and a still more conclusive experiment in this direction was made by Gavarret. He enclosed in a tight box a small animal and arranged to supply it with the necessary oxygen while taking away the carbonic acid produced. The animal died, although it had never suffered from the action of carbonic acid. Its death can only be attributed to the presence of organic matter.

These substances which give to the room inhabited for a certain time an odor *sui generis* tend to accumulate in the top part of the room. A great number of experiments have demonstrated this tendency of the vitiated atmosphere to rise to the ceiling. A few instances will suffice.

A ball was given in a hall which was not properly ventilated. The people in the gallery were taken with vertigo, while those in the lower part of the hall were in no wise disturbed.

A workman having ascended a ladder to the ceiling in a room containing a large number of people, had to come down to breathe, while those who remained on the floor did not feel the least uneasiness.

In this connection might also be quoted the well-known fact that metals become sulphurized much quicker when placed near the ceiling than when they are left in the lower portion of a room.

It being granted that vitiated atmosphere has a tendency to rise, why not take advantage of this natural current by placing the outlets near the ceilings?

When,—and it is very often the case,—the fresh air is introduced through the top of the room, it must necessarily pass through the vitiated atmosphere; and thus it brings back a part of the impure air to the inmates.

The consequence is that it becomes necessary to introduce enough fresh air so that after the mixing with the vitiated atmosphere the proportion of carbonic acid shall not exceed the sanitary limit. How much fresh air is required under such circumstances?

For an example, we shall suppose a class of 50 children of 12 years of age. The necessary horizontal space for every child being 15 square feet, and the height of the ceiling being from 12 to 10 feet, the quantity of air per capita will be about 150 or 180 cubic feet, being a total for the whole class of 7,500 cubic feet.

Dr. de Chaumont, after 473 analyses, arrives at the conclusion that the atmosphere, to be breathable, must not contain over .02 per thousand of carbonic acid over the natural proportion. On the other hand, taking it as granted that every child of the average weight of 80 pounds exhales 0.4 of carbonic acid per hour, the 150 feet of space alloted to each will contain at the end of an hour 2.66 per thousand of carbonic acid. The atmosphere under such conditions is unfit for respiration.

To restore the proportion of 0.2, it would be necessary to dilute the air in 1,850 cubic feet of fresh atmosphere, or about thirteen times its original volume.

That is the result given by the application of the following formula of Dr. de Chaumont, viz.:

R = Proportion of carbonic acid contained in the fresh air introduced.

r′ = Proportion of carbonic acid contained in the vitiated atmosphere.

C = Capacity of the room.

r = Limit which cannot be exceeded and to which it is necessary to reduce the vitiated atmosphere.

d = Quantity of fresh air to be introduced.

V = Total quantity of air (equal to c plus d). The result will be:

$$R \frac{r'—R}{r—R} \times C = V. \quad V—C = d.$$

which transferred into figures gives:

$$\frac{0.00266}{0.0002} \times 150 = 1{,}995.$$

The quantity of air to be supplied will be 2000—150=1850.

The school commissioners of the District of Columbia, in their report of 1882, put the volume at 30 feet per minute, equivalent to 1,800 feet per hour. That quantity, we hold, is very much more than necessary. According to General Morin, 700 or 800 cubic feet are sufficient for a child, and many French authorities consider even this estimate as too high. In the schools recently erected in France, and where the system of outlets at the top has been adopted, it has been possible to reduce to 400 feet the supply of air to be introduced in order to keep the proportion of carbonic acid below the recognized limit.

We therefore feel justified to conclude that it would be sufficient to introduce 400 cubic feet per hour for every child, provided that the fresh air enters from below, at a temperature of five or ten degrees below that which should be maintained in the room, and that the vitiated atmosphere be expelled upward. Moreover the inlets should be as near as possible to the children, and their area should be such that the incoming current will not be swift enough to raise the dust from the floor nor to produce the effect of a cold draft; that is to say, that the speed of the current should not exceed two feet per second.

The flues should be arranged so that they can be easily reached at all times and kept in a perfect condition of cleanliness. The elbows should be as few as possible, as they have a tendency to increase the friction and bring about accumulation of dust.

Having ascertained the quantity of fresh air which it is really necessary to obtain, we must next look to the means to be taken to secure it.

The old time process of refreshing the room by opening the windows during recess can be dismissed with just a mention. Its efficiency is very doubtful—we might even say that it is utterly useless. As a matter of fact, we have already seen that after a room has been occupied one hour the atmosphere contains 2.66 of carbonic acid. Even if every pupil had double the space allotted to him and the class only lasted an

hour and a half, we would find a proportion of 1.94 of carbonic acid which is far greater than admitted by any sanitary authority.

There remains consequently to be considered

First: Natural ventilation.

Second: Ventilation through a heated chimney.

Third: Mechanical ventilation.

In certain climates natural ventilation through the windows is possible; but here, the difference between the temperature of the rooms and that of the outside is so great, that we do not believe the plan is practicable. Under such conditions, the fresh air can be heated only by mixing with the vitiated atmosphere, and we have already shown that it is highly important to avoid this mixture.

The many arrangements devised for ventilation through the windows, such as perforated panes, English double windows, openings provided with revolving ventilators, do not improve the system. If by any means the mixture of the pure and vitiated atmosphere is prevented, the result is a cold draft, there remains then only ventilation through chimneys and through mechanical devices.

We believe that the most satisfactory solution can be reached by combining these two systems.

Mechanical ventilation in cities is not now so difficult as it was years ago. The motive power for the elevator can be easily supplied by electricity, which is so conveniently and cheaply transmitted. The plant need cost but very little, and the running expenses are very low.

As to the advantages they are too well known that we should dwell on them here. In order to save the time of this convention, we hasten to conclude that the best mode of ventilation in school buildings is a mechanical system which would cause a volume of from 400 to 500 cubic feet per pupil to circulate from the bottom to the top of the room, the fresh air being heated before its introduction to about five degrees below the temperature of the room. The heating apparatus placed in the rooms to compensate the loss of heat through the walls should be arranged in accordance with this plan.

Question: In cold climates, can small openings of windows be called proper ventilation?

MYOPIA IN ITS RELATIONS WITH SCHOLASTIC HYGIENE.[1]

By DR. A. A. FOUCHER,

Professor of Clinical Ophthalmology and Otology, etc., at Laval University, Montreal.

Is myopia an inevitable evil, offering little importance; and should we consider this breach of refraction, in the light of a Darwinian theory, as an adaptation of the eye, in conformity with the requirements of our civilization?

This question might have been asked formerly, but viewed through the lens of modern researches and discoveries of eminent men and of different countries, myopia, like many other affections, arises as one of the common, if not constant, consequences of the breaches of hygienic laws. We have even been so far as to express the opinion that this error is not an accident of birth, but that we may have a certain hereditary predisposition to it; and that it appears only under the influence of labor, maintained and prolonged, and wrought in an insufficient or unfavorable light.

Notwithstanding our reluctance in accepting such an absolute theory, which leaves us no satisfactory explanations of severe myopia in quite young subjects, we are, nevertheless, convinced by personal experience, that myopia progresses rapidly under the influence of faulty hygienic conditions, consequently it is not always inevitable.

Donders has resumed its importance in these few words: "A myopial eye is a diseased eye."

If light myopia bring forth, as its only inconvenience, the necessity of wearing concave glasses; considerable myopia develops, as a consequence, much graver disorders, amongst which we must mention: muscular insufficiency, amblyopia, choroiditis, scotoma, and retinal detachment.

Generally speaking, the eye afflicted with myopia is an extremely delicate organ, which should be but sparingly brought into use, therefore we cannot exact from it the labor which we have a right to expect from an emmetropic eye.

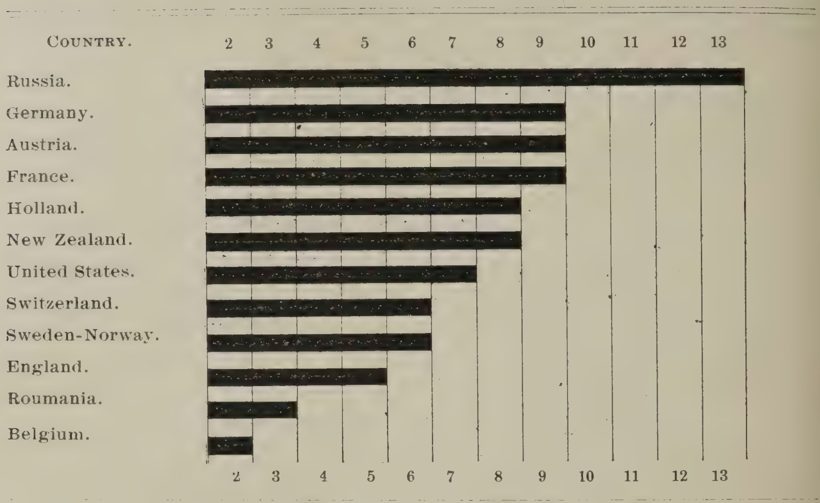
The eye, though by far the greatest organ of the enlightened, may remain stationary in its state of congenital refraction, providing it be subjected to the hygienic laws prescribed by the wise interpretation of the mechanism of sight.

It is not our desire here to enter into the physiological study of vision, nor yet into the mechanism of myopia; this latter subject is still in controversy. It is, however, of small importance to hygienists, whether this anomaly of refraction be hereditary or not; whether it preferentially develops itself amongst those who have a certain peculiar formation of

[1] Read at the Montreal meeting.

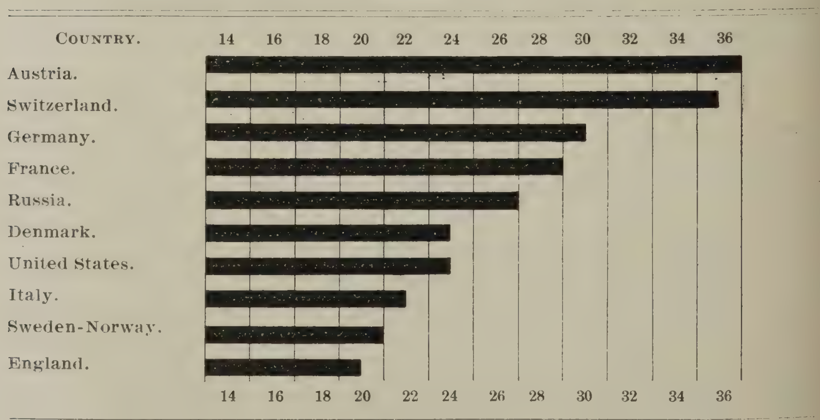
PERCENTAGE OF MYOPIA IN PRIMARY SCHOOLS.

Per cent.



PERCENTAGE OF MYOPIA IN SECONDARY SCHOOLS.

Per cent.



the cranium, or of the orbit, observed in some races more than in others; whether the ciliary muscle and the muscles of motion of the ocular globe contribute severally, conjunctively, or not, to its development; and finally whether certain diseases of the eye, keratitis, iritis, choroiditis, or a constitutional diseased condition be, or not, considered as predisposing causes. What is of importance to be known, in order to prevent, are the *remediable* conditions in which myopia tends to develop itself in preference.

This information is afforded us by statistics raised in primary and secondary schools of different countries. Despite the fact that these extracts do not always favorably compare with one another, owing to the different manner in which they are computed, they have, nevertheless, established an important fact, namely: that myopia is more prevalent in the secondary schools than in the primary, as well as in the higher more than in the preparatory classes. The accompanying chart illustrates this fact, as it also shows in what countries myopia is most developed.

The number of myopes in the primary schools in Russia has been ascertained to be 13 per cent. whereas the secondary schools of the same countries show 27 per cent. Austria affords a still more striking contrast, there being 9 per cent. in the primary, where 37 per cent. occurred in the secondary schools. France illustrates another remarkable instance known to many of us; it is the large number of myopes amongst the scholars who frequent the polytechnic schools. Moreover, it is an undeniable fact that one half the greatest learned men have been afflicted by myopia; and it is more prevalent in countries given to classical culture, such as Germany, Austria, and France, whereas it is barely perceptible, almost unknown, throughout populations exclusively pursuing agriculture and navigation.

The source once known, preventative hygiene has but one object to pursue, its entire eradication, or the mediation of its effects within the bounds of possibility.

Is it because learning and deep study are conducive to myopia, that we must fetter the progress of science in order to remedy the evil? Certainly not; all that is necessary to be done is to subject the labor of the eyes to hygienic laws, simple and easy of application.

Within a few years, efforts have been made in all countries to ameliorate the conditions in which we have toiled, and in which new generations toil, in grammar, mathematics, geography, Latin, Greek, etc. They have also endeavored to furnish the pupils with better light, a more plentiful supply of air, and of a superior quality; shortened studies are demanded from them; their seats and desks which, indeed, were but instruments of slow torture, gradually disappear and are being replaced by furniture more in keeping with their lessons, age, and build; their books, which were badly printed, the lines irregularly distanced and in too small characters, are giving place to new and faultless editions;

all of which bears evidence of the progress accomplished in scholastic hygiene. Can we infer from the foregoing ameliorations that no improvement remains to be performed in that respect? Decidedly not!

There exists in the Province of Quebec a great number of institutions where the lighting and furniture are still defective; a far greater number exists where the posture of the scholar is insufficiently looked after, where are tolerated vile positions of the head, where the eyes of the scholars are subjected to prolonged labors, and finally where the professors neglect to advise the pupils, who work, or read, and hold objects nearer to the eyes than 27 centimeters, to consult a physician who knows, or can find, the means of remedying the error.

When a child feels the need of approaching objects nearer to his eyes, so as to procure larger retinal images, it is a proof that the lighting is insufficient, the impression of the class books defective, the ink too pale, or the characters too small; that the cornea is afflicted with opacities, that the fundus of the eye is in fault, or that the refraction is not as it should be. It is necessary then to submit the child's eyes to a detailed examination so as to well establish the true cause of the vicious attitude of the head. If the membrane of the eye has got thinner, jagged in some points; if the papillary disc wears already a small crescent; if there exists any evidence of insuffiency of the right internal muscles, the future of the eye is in danger, and the future years of study are severely menaced for the ultimate integrity of this organ. It is necessary in certain cases to stop the studies for fear of aggravating the myopia, making it progressive and seeing it pushed to extreme limits, the visual acuity is definitely lessened.

In other cases, it will be sufficient to wear appropriate glasses which allow reading at 27 centimetres, and to submit the myopes to all the hygienic exigencies which comport the state of their eyes.

In all cases, it is necessary to apply to children of all schools rules for work bearing (1) upon the age at which it is convenient to fix the beginning of sustained work; (2) upon the quantity of such work, relating to each period of childhood; (3) upon the manner in which this work should be conducted according to hygiene.

If it is not prudent to submit the eye in course of development too soon to the exercise which necessitates study; it is not without importance that in the struggle for life especially at the present time the children should not wait too long to begin school-work.

In any case, long written tasks should be suppressed, long exercises of reading and writing should never be imposed on children under six years of age.

The duration of studies for the second period of childhood, that is children from seven to ten years, has been fixed by hygienists at three or four hours a day; between the ages of ten and thirteen, five or six hours of classes is allowed daily, besides two hours of study at home. These hours of study should not be continuous; it is important to inter-

pose frequent recesses. The holidays and Sundays should be employed to their true destination.

The satisfactory distance for reading and writing is from 22 to 33 centimeters. The seats should be constructed in such a manner as, although allowing a good demeanor from the scholar, to put him in a position to read and write at a convenient distance. The body should be kept upright on a straight copy-book. As to the direction to be given to the writing, opinions differ on this matter; the French write in an upright manner; we have in England, in the United States, and in Canada, the method, good or bad, of writing bent from right to left, and it would be a hard task to oppose any modification with a chance of success.

The printing of the books is a detail which is of the greatest importance. The manuals should be legibly printed in black letters on white paper or, still better, on pale yellow. The elevation of an N, for instance, should be of $1\frac{1}{2}$ millimeters, at least; the thickness of the strokes of $\frac{1}{4}$ millimeters; the distance of the letters between themselves $\frac{3}{4}$ millimeters; the interlines of $2\frac{1}{2}$ millimeters; the length of the lines of 10 centimeters at the most. In all these calculations, it has been necessary to take account of the fact that to be visible, an object should sustain on the retina an angle of at least 5°.

As to drawing and needle-work, we should never exact from children works of that kind unless they can be comfortably executed at the distance of 35 centimeters at least, and never begin such works before the child is ten years old. Choose for such works the best lighted rooms, and do not prolong the work more than three fourths of an hour at a time and even then allowing the eyes to rest frequently.

The question of lighting is one of the most important, and should be considered in reason of its quantity, quality, and mode of distribution. In a few words, the best lighting is that of the sun and next to it comes the electric light. The direct solar rays are good for the salubrity of the class but falling on the desks they simply dazzle the eyes and do not help; for the work it is necessary to darken the light with curtains.

The distribution of the light should always be made at the left of the scholar; if the unilateral light is used, the height of the upper part of the window, measured from the floor of the school room, should be, so says Trèlat, equal to two thirds of the width of the class, enlarged by the thickness of the wall in which the windows are pierced.

Artificial light never sins by excess. It contains a large quantity of yellow and red rays and also calorific rays; these last are prejudicial to the eye and for this reason the luminary should be placed far from the head. The artificial light should be sufficient and steady, one round gas burner is enough for four scholars.

If the scholars feel any fatigue at night, when reading, it is not because the artificial light is too strong, it is rather because it is insufficient. In placing the light over the head, the heat has a tendency to ascend and

by so doing you avoid to the child the direct action of the radiation but at the same time diminish the light. The school room must be provided with a sufficient number of artificial lights so as to make the work easy at the distance already indicated, and it is necessary also that the ventilation be sufficient to eject the excess of calorific as soon as it develops itself.

All these hygienic conditions which should be applied to schools and several others which it would be too long to enumerate here, have already been the object of discussions in different congresses of hygiene, and have been partly or totally adopted in certain countries, especially in Germany and France. In view of reducing in this country, as well as in others, to its simplest proportion the number of myopes or the degree of myopia, authorities should be obtained to enforce the laws of scholastic hygiene.

But each province has its mode of governing and ruling schools, and it would be difficult to formulate a uniform mode of procedure. As far as the Province of Quebec is concerned, we have full confidence in the efficacy of the provincial board of hygiene.

This authority is ample enough to carry out the enterprise; and the success which has already crowned its efforts in the difficult task of rendering hygiene popular in this province, endows us with the firm conviction that if they so desired, they would arrive by laws, diplomacy, or persuasive means, to have this service penetrate into the educational institutions, where our children must needs acquire not only the knowledge which improves and adorns the mind, but also the health requisite to put that knowledge in practice, and to fulfill their various destinies.

DISCUSSION.

Dr. H. R. Hopkins, of New York:

Mr. President: I want to put in a word of disclaimer as to the relation which is so frequently and gratuitously charged to school life in the production of myopia. I think it is a rather popular belief that a very large proportion of the cases of myopia are found to exist in children as the result of abuse of their eyes in study. After twenty-eight years of practice of medicine among children we are accustomed to spend some time in school. I simply want to state my conviction that I have not yet met a child whose eyes were injured by study in or out of school. This may be heresy, but I believe it is a free country, and some of us may be permitted to be heretical. It is my judgment that the popular circulating library, the cheap novel, is responsible for many cases of myopia, for the simple reason that the boy or girl buries himself in these books not by the minute, but by the hour. From what I know of the young they do not confine themselves to their books with that sort of intensity and persistence that tires their eyes, and where their sight is injured I think it is attributable to a greater or less degree to the reading of novels for two or three hours at a time. It occurs to me that it is an entirely proper thing

for us to take hold of the supervision of the print of school books. I have seen books which were sold for use in public schools, the print of which was simply abominable, and very trying to the eyes of any one, no matter how strong. Where there is no provision made in our school system or in our protective health system, it seems to me, it is a proper matter for us to supervise in order that the print which is given to the young shall be legible and easily read.

Dr. Lewis.—While, as Dr. Hopkins has said, myopia is brought about in many instances by bad print in the books used in our public schools, there are other etiological factors to be considered, and one is imperfect ventilation. It is a well-known fact that other causes produce myopia besides eye-strain, which is the exciting cause. We have congestions of the choroid and softening of the coats of the eye. Improper hygienic conditions of the schoolhouse would be the principal cause.

HYGIENE IN MEDICAL EDUCATION.[1]

BY DR. J. I. DESROCHES,

EDITOR IN CHIEF OF THE POPULAR JOURNAL OF HEALTH, MONTREAL, MEMBER OF THE BOARD OF HEALTH OF THE PROVINCE OF QUEBEC, ETC.

To speak of hygiene in medical education before the American Public Health Association composed, as it is, of members enjoying so distinguished a reputation, is to undertake a difficult task; but, gentlemen, I rely on your indulgence.

The doctor's true sphere of action is not confined to disease alone, it embraces man's whole life in a state of health, as well as when indisposed; for health even like disease has its laws. It is a matter of consequence that the physician should know how to preserve the first as well as he does how to treat the second, for he must not only cure the patient, but also strengthen him, and protect his health, which can be done only by leading a life in conformity with the rules of hygiene.

Hygiene is as essential to the healthy as it is to the sick and convalescent. If many diseases arise from violating the rules of hygiene the same cause may aggravate or render diseases incurable. In our own days do we not see the number of avoidable diseases increasing, with the progress of science, and the means of preservation also increase in number and power? Can it not be proved that there is a constant diminution of these diseases before the wonderful march of hygiene and of civilization?

Hygiene has conquered public opinion; to-day it is considered as one of the indispensible acquirements in the education of the people. At the present moment no person can contest its humane importance and civilizing influence, which have reached such a degree that this science has attained the point required to become a social institution, an administrative power. Under its "Labarum," which now waves over all civilized people, thousand of savants of all classes have assembled, all disposed to labor in the development and diffusion of this science. In this grand army of hygienists physicians represent the infantry, that is to say the principal corps, that which directs the battle and leads on to victory. It cannot be otherwise, because hygiene is the synthesis of medical science. Physicians shall always hold themselves bound to accord the freest welcome to chemists, engineers, architects, economists, moralists, and statisticians, because these are skilled men, useful in the advancement and application of hygienic principles. The general interest which inspires modern hygiene, the ardor with which people throughout the land engage in it, the noble role which physicians are called to fill in this humane

[1] Presented at the Montreal meeting.

movement become more important every day; the place that this science has taken in medical instruction in France, in Germany, and elsewhere, compels us fearlessly to consider the point we Canadians must arrive at to give this science due prominence in the faculty of medicine, that is, assign it a place in matter of examination for the degree of doctor.

Public interest and medical honor demand hygienic instruction more in conformity with modern progress. It is time for the faculties of medicine to consider the medical profession as an extremely powerful lever in hygienic operations, and a means of offering to diffuse this humane science within reach of the masses. So long as hygiene is ignored by the greater number of physicians, its individual and social value shall be contested; there will always be quite a large number of families who shall consider it as something troublesome and oppressive.

The doctor is one in whom families confide, his duty is to preserve the health and life of the people. He enjoys general confidence and, in times of epidemic, he exercises great influence in society. In possessing a sufficient knowledge of hygiene the physician witnesses the utility of this science among the masses; he understands the role assigned him by the principles of hygiene in the struggle against infectious diseases, and against the progress of epidemics; he makes it his duty to utilize practical sanitary appliances, because he knows that public health is a matter of the first importance to a nation, and that he, the physician, is the chief person charged with its preservation.

The physician needs the enlightenment of hygiene in the exercise of his profession; for hygiene occupies the first place in the treatment of diseases, particularly virulent, miasmatic, and pestilential diseases. In these conditions hygiene and medicine render mutual assistance at the bedside of the patient: Hence the obligation for every physician to study the science of hygiene and to take cognizance of its progress.

It is an incontestible fact that one third of the deaths in the Province of Quebec to-day is occasioned by avoidable diseases, and this is a consequence of ignorance on the one side and a lack of confidence in applying efficacious hygienic powers. A more complete knowledge of the teachings of hygiene, more rational ideas on the nature and cause of diseases, would establish a more evident amelioration in the conditions of existence, and consequently a greater diminution in the morbid causes which exert an ominous influence on our people. To arrive at happy results, there must at first be introduced into the education of all physicians, in the future, a profound knowledge of hygiene. They must understand its high aim, its programme embracing all the aspirations of humanity with all its tendencies to physical, intellectual, and moral perfection which is combined in the one word—progress.

In preventive, as well as curative, practice a knowledge of the cause of diseases is essential. That every rational system must be based on this point is evident. Real and important results can be expected only from observation and scientific deductions. The progress made during the

last few years in physiology, histology, and pathology; Pasteur's fine discoveries, which have so recently developed the question of infectious diseases and their prophylactics, are well adapted to excite our enthusiasm in favor of hygienic science. To-day it is almost impossible to overestimate the scientific researches which have led to the antiseptic methods of counteracting the effects of microbes.

Before the light of modern hygiene the quarantine system is superseded by medical superintendence, by isolation of contagious diseases, and by disinfection. Do we not see that awful disease, diphtheria, clear out of the household immediately after its first appearance before isolation and disinfection? And it is so with all other contagious diseases.

The study of bacteriology, so widely diffused at present, with a tendency to produce important results as regards both life and health, has a right to figure in medical instruction. Hygiene should be one of the most important subjects in medical education, the first, we might say, in order to make this science a reality. But we must not be alarmed at the vast extent of this science. A matter of the greatest importance is to begin well the study of such a subject. It is of more consequence to thoroughly understand the fundamental principles and recent discoveries, that may be utilized for an established purpose, than to enter into the details of the science which hygiene applies.

At the international congress of Vienna, in 1887, Dr. Smith of London said:

"Hygiene is widely diffused in England, but a very great number of physicians do not understand this science, and in case of infectious diseases these doctors consult specialists to find the cause of the disease, and to learn the best sanitary measures to adopt in such cases."

We can say to-day that in Canada quite a great number of physicians lack sufficient knowledge to make competent use of public remedies and to constitute themselves the valiant defenders of the lives and health of the people. To account for the reason of this deplorable state of affairs it is necessary to return to the question of medical instruction. Hygiene does not yet hold the place that it merits in medical studies. Hygiene is taught in the first years of medical study, when the student has not yet acquired that amount of knowledge necessary to understand its principle and to grasp the whole practical importance of the subject. That hygiene is the synthesis of medical science seems to be forgotten.

At the faculty of medicine in Paris, the teaching of hygiene ranks after that of physics, chemistry, natural medical history, histology, physiology, general pathology, internal pathology, external pathology, practical medicine, and midwifery. This teaching is embraced in the programme of the fourth examination of medical studies. With such instruction, France has reason to hope that she will have before long a phalanx of physicians well versed in the science of hygiene and in French public medical practice.

We all understand the utility of hygiene in medical education, and the necessity of teaching it in medical faculties is in conformity with the

importance of this science. This reform is now very urgent in the Province of Quebec, because hygiene has entered into the path of progress. We have now a board of health which manages public hygiene; a journal of health which operates in making the science popular and thus really practical. Hygiene is also introduced into the schools, which goes to prove that this science is understood by our masters in pedagogy. The era of the health congress, opened at Brussels in 1851, still continues. During these last few years we have seen congress after congress assembled by the impetus of hygienic progress. This year, for the first time in the Province of Quebec, Montreal is the seat of a health congress. We see here united a great number of learned men from all parts of North America. This is a noble demonstration. How common are sanitary interests, how very identical are questions relating to health in every country! Meetings of this kind popularize and develop hygienic knowledge already acquired. These assemblies bring together learned men; they establish between them fruitful and amicable bonds of co-operation; they cause the learned public to participate in a movement to which they would remain strangers, were it not for these solemn occasions.

Now what do we see at the head of these learned assemblies? The physician who utters the rallying cry, who impresses a current of most interesting ideas, here signalizing a necessary reform, there an important modification, besides pointing out a means prolific in practical results, giving everywhere and always a fresh impulse to the development and diffusion of hygiene. He fills an admirable role in the advancement of this science, and this is one of his most beautiful titles of glory. In order to acquit himself nobly and liberally in his duties as pontiff of hygiene, the doctor should possess a great amount of knowledge, so that he may anticipate the questions about to be presented, consider their different features and extent, reply to them, and be able to justify the replies that he gives.

For this reason it is of public interest and medical honor to establish a special course of experimental and applied hygiene in every faculty of medicine, and to have in these faculties laboratories and chairs of hygiene; the teaching of this science during the last two years of medical study cannot be dispensed with; the proof of sufficient knowledge in this science should be exacted in order to obtain the diploma of doctor in medicine.

It would be also desirable to introduce a complete and systematic course of hygienic instruction into the faculties of medicine, a course of which I will here submit a summary sketch.

1. Private and general hygiene (of man in general and as an individual; of the atmosphere and respiration; of the climate, soil, water; of food and alimentation; of clothing; of corporal cleanliness; of dwellings and their dependencies; of labor, exercise, repose; of inferior organisms).
2. Demography.
3. Social hygiene.

4. Infantile hygiene.
5. Scholastic hygiene.
6. Rural hygiene.
7. Hygiene of cities.
8. Industrial hygiene.
9. Hygiene relating to soldiers and sailors.
10. Hygiene of prisons.
11. Hygiene of public edifices, hospitals.
12. Burials and cemeteries.
13. Of virulent, miasmatic, and pestilential diseases—etiology and prophylactics.

Of hygienic organization and the public practice of medicine in the different countries, as well from a national as an international standpoint; sanitary authorities and agents; laws and penalties.

Here I conclude and deliver these pages to the close attention of those who govern the faculties of medicine. These men should urge the professors to consider the privileges and prerogatives that the physician has a right to enjoy in the grand army of hygienists.

They should understand the relation which to-day exists between all nations regarding *les infiniments petits*. Each one of us knows that microbes are man's most formidable enemies; though conqueror of the lion and tiger nevertheless man is vanquished by these microscopic beings. As hygiene has already signalized its omnipotence against the enemies of our health, the physician should not hesitate to be guided by the light of this science in the accomplishment of his social mission, which is one of devotedness and sacrifice, calling him to render the most eminent services to the family and to society.

Finally give place to hygiene in medical education, this eminently social and humane science par excellence.

Forward!

THE PRESENT STATE OF SANITATION IN MONTREAL.[1]

By L. LABERGE, M. D.,
Medical Officer of Health, Montreal, Canada.

In this paper, I give a rather brief outline of the present state of sanitation in Montreal, as also a synoptical statement of the most important phases in the development of the measures concerning public health in our city.

This subject being of a local nature, is not quite so interesting as one of a more general character which might present new ideas or suggest questions for discussions that would prove of interest to the members of this convention. Yet this society, being one that interests itself in all that concerns hygiene, will probably not be displeased to obtain a fair idea of our present state as regards sanitary progress. Besides we desire to avail our ourselves of the present opportunity to place before you our true position and to remove, so far as possible, certain prejudiced views which may be entertained regarding our sanitary organization and the measures taken to preserve and to promote public health in this city. A further apology for the form in which this document is presented is, that a dry, chronologically arranged statement would likely not be so acceptable.

STATISTICS.

The conclusions drawn from the statistics being the guide for sanitary authorities, and placing them in a position to ascertain the cause of danger to health, as well as to warn them of its presence, it would seem best to commence my paper with a few remarks on this subject.

The correctness of statistics depends naturally upon the method adopted with respect to their collection. In Montreal, for the statistics of births and marriages, we have to depend upon the information contained in the registers of the churches of various denominations, duplicates of which are deposited with the prothonotary of the district, in accordance with the provincial laws; but for the deaths we have a special provision in our charter which authorizes the enactment of the sections of By-law No. 105 which give us power to exact much more information (and that of the most important character) than the provincial statute requires in the ecclesiastical registers, notably the cause of death.

BIRTHS.

It is to be observed that it is the baptisms and not the births that are obtained by recourse to the ecclesiastical registers, as only those who are baptised or circumcised at birth are given. The total number of births

[1]Presented at the Montreal meeting of the Association.

thus obtained does not fall far short of the actual number that takes place.

However, the births amongst a few nominal Catholic Protestants who do not baptise their children at birth, and the females amongst the Jews, escape registration, with the exception of the few who are registered at the Health Department in accordance with the provision of section 53a of the Civil Code of the Province of Quebec, which forms a complement to the ecclesiastical registers. This clause requires the registration of all children unbaptized within four months from the date of birth; but there being no penalty imposed for either neglect or refusal to comply with the law it remains a dead letter. The register kept in our Department requires even a more complete statement of facts than that demanded by the office of the Registrar General of England. The details given in the church registers are not quite complete enough to meet the requirements of the science of demography, such particulars as the age, and origin of the parents, whether the births were the result of a first or second marriage of either or both of the parents, and the domicile (street and number) being wanting. The residence of the parents is of special importance in connection with the vaccination service.

MARRIAGES.

The information obtained with respect to these is correct so far as the total number is concerned, but it is important that the origin and the age of the contracting parties should be given, the distinction required by the terms of the law with respect to the latter particular, namely, major or minor, being too vague.

INTERMENTS.

The ecclesiastical registers do not give the cause of death, but, according to provisions of the charter of the city, and By-law No. 105, lists containing this additional information, as well as other details, are received weekly at the Health Department, and form the matter from which the statistics of the department are compiled. These lists are based upon the medical certificates exacted by the board of health, which are supplied to all medical men. In order to render the returns of death as complete as possible, transit permits are issued by the department in exchange for the certificates of death in the case of the bodies of persons that are removed to places of burial not under the jurisdiction of the Montreal authorities.

According to the existing laws, the death certificates are transmitted first to the keepers of the cemeteries, and in many cases only reach the department after interment takes place. In cases of contagious diseases, it is evident that this procedure occasions too great a loss of time. This reason, as well as the greater accuracy that would be gained by the immediate supervision by the department of the certificates, would suggest the advisibility of causing them to be directly transmitted to the

health department. It would be necessary, however, to apply to the provincial legislature for an amendment to the city charter before the above mentioned change in the law could be made.

LEGISLATION.

One of the most important requirements to enable the authorities of a city to put the territory under their control in a proper condition from the point of view of health, and to preserve the community from the invasion of disease from the outside, is a wise, prudent, and complete legislation. The charter of the city was obtained in 1840, and before this the laws of Lower Canada governed sanitary measures. In 1863, an endeavor was made by the health committee of that time to obtain all possible information as to the laws then existing in the principal cities of Europe and America, with the evident intention of framing ordinances of a similar nature in accordance with the wants of our city. But it was only in 1872 that a by-law of a specific but very incomplete character was adopted, namely that entitled No. 58, concerning drains and cesspits. By-law No. 105 was the first attempt to make a complete law concerning the most important subjects relating to health. It was based upon the provisions of the English public health act of 1875, but it was drawn up in such general terms as to be difficult of enforcement in very many cases.

Several amendments have been made to this enactment, the most important of which were,—By-law No. 135, requiring the removal of all tallow-rendering and soap factories beyond the limits of the city; By-law No. 187, regulating the inspection and sale of milk within the city; and By-law No. 215, which is a development of a very thorough and precise nature of certain sections of 105, adopted only in the month of June this year. It is entitled, "By-law concerning plumbing, drainage, and ventilation of buildings." In this enactment, specific rules respecting the manner, even to details, in which work of the above nature must be carried out, are given.

In 1877 a commission, composed of the city attorney, city clerk, and the clerk of the recorder's court, was appointed to prepare a complete code of sanitary by-laws for the city. An elaborate draft of law was drawn up by the clerk of the recorder's court, based upon laws of the same nature as those existing in England and the principal cities of the United States. The two former gentlemen, however, thought that it might be rendered more concise, and accordingly drafted another by-law. Both drafts were submitted to the board to be studied and reported upon, but, although this matter had engaged the attention of both the members of the board and experts for months and even years, nothing has come of all these labors.

In this province the procedure with reference to legislation is rather lengthy. In the first place, application has to be made to the city council, next to the legislature of Quebec, then the affair is referred to the

legislative council for approval; after this, the powers thus obtained, which are in the form of amendments to the civic charter, do not come into force until formulated into by-laws and promulgated by the city council.

BOARD OF HEALTH.

The affairs of the city were administered by justices of the peace from 1796 to 1832, in which year the city was first incorporated. In 1840, the second act of incorporation was obtained; and in 1867 the civil code promulgated by the government, containing certain provisions relating to health. Previous to this and to the adoption of regular sanitary laws by the health authorities, the common law furnished the power exercised in matters relating to health. The common law in this country is simply the criminal law of Great Britain, which at the time of the cession of Canada to England was accepted as such, the French law being allowed to prevail in matters of a religious or civil nature. Immediately after the obtaining of the city's second act of incorporation in 1840, a joint committee on health, consisting of the members of the health and police committees, was formed. In 1874 a health committee was appointed comprising aldermen and citizens outside the council, which exercised all the power and privileges enjoyed by the council itself respecting matters of health.

By a proclamation of the lieutenant-governor in 1885, the board was constituted "The Local Board of Health" for the city of Montreal. Since 1886 the board has consisted of the same number of members as the other committees, namely, seven, and these aldermen only.

STAFF OF THE HEALTH DEPARTMENT.

It was only in 1847, according to the records of the city council, that special officers were detailed to look after the sanitary condition of the city. In that year two inspectors were appointed. The number was slightly increased in the years intervening between 1847 and 1872, when in addition to the permanent staff ten temporary inspectors were appointed to act for a period of three months. In 1874 the number of temporary inspectors amounted to twelve and acted during March, April, May, and June. These inspectors were under the control and direction of the deputy chief of the police force until 1876, when he returned to the police service and was replaced by a chief sanitary inspector.

Two medical officers acted as advisers of the board for a number of years, but gave only part of their time to the affairs of the department, and in 1874 it was considered better that only one health officer, devoting his whole time to the direction of the business of the health department, should be named. In 1885 the first permanent officer appointed in Montreal retired and was replaced by the reader of the present paper.

The epidemic of 1885 although a deadly and expensive one, nevertheless had the effect of deciding the civic authorities to augment and perfect

the organization of the Sanitary Department. One of the most desirable additions made was the appointment of three permanent vaccinators and a permanent disinfecting officer. The board have reason to congratulate themselves upon having appointed so valuable an addition to the staff. Another nomination which took place in 1889, that of a milk inspector, was received with the greatest satisfaction by the public. This service is of paramount importance in view of the necessity of providing good and pure milk for the infantile portion of the population. In order to more fully guard against the propagation of tuberculosis or any other disease through the milk and to ensure its being the standard quality required by law, two veterinary surgeons were appointed lately to inspect not only the milk but also the cattle and dairies which form the source of our milk supply.

The sanitary police force in 1885 numbered twelve and remained at that figure until 1892 when ten additional, but temporary, men were added. The augmentation was owing to the extra work occasioned by the special measures taken to put the city in the best possible condition in anticipation of a probable visit of cholera. In 1893 the number was reduced to that forming the ordinary staff of inspectors. From March to June, this year, twelve supernumerary inspectors were named to assist the regular force, which at present consists of seventeen members.

It has been really encouraging to witness of late years the rapid development of our organization, more especially in departments hitherto quite neglected. The appointment of a sanitary engineer, which had been for years asked for, took place in 1893 and the services of the incumbent of that position has rendered show the wisdom of our civic legislators in creating the office. The city undertook to carry out through the Health Department by means of their own employés a scavenging service, which has certainly proved a wise measure and one that the citizens have fully appreciated. This service is under the supervision of a special officer whose duty it is to see that the work is properly carried out.

CONTAGIOUS DISEASES.

The contagious diseases which the laws and regulations of the province and of the city require special attention to be given to, are those that have been found in our community to have the greatest tendency to spread and at times to become epidemic, namely, small-pox, cholera, diphtheria, croup, scarlatina, measles, and typhoid fever.

The reporting of such cases to the health department is obligatory on the part of the attending physicians and, in the case of there being none, by the relatives or other inmates of the house in which contagion exists.

The authorities are very strict with respect to small-pox and cholera cases. Should the law be wanting in any detail that public demands attention to be given, then the necessary action is taken despite the want of legal authorization.

With respect to the other diseases, we are more lenient, and isolation in hospital is only made compulsory when a case occurs in an hotel, a boarding-house, or the like. But in all cases of diphtheria and scarlatina the house is placarded, to warn the public, until the danger of contagion has passed.

CIVIC HOSPITALS.

The board of health contemplated for some time the establishment of a permanent fever hospital, distinct from the civic hospital at present in existence, and which is designed solely for small-pox patients.

It is under the exclusive control of the city, and has at all times 120 beds ready for the reception of patients. The first step towards the establishment of this hospital was taken in November, 1874, when, despite the opposition of the park commissioners, all the property on a retired portion of the Mount Royal park was forcibly taken possession of by the health authorities as a temporary small-pox hospital. To ensure possession of the building, a couple of cases of small-pox were at once placed in the beds prepared for their reception in this building. So soon as it was learned that the hospital was actually opened, and that patients had been already placed therein, opposition to the occupation of the building for such a purpose ceased for a time. Later on the building was enlarged, and, as it threatened to become a permanent hospital, clamors arose against Montreal's principal park, and one of the most inviting both to the citizens and to tourists, being desecrated by the establishment within its limits of a pest-house. Nevertheless, it remained the civic small-pox hospital until after the epidemic of 1885–'86. At the time of this epidemic, when extra hospital accommodation was required, permission was had from the government to use the buildings upon the exhibition grounds temporarily for the reception of a large number of patients that could not be admitted into the already over-crowded hospital (St. Rock's) upon the Mountain Park grounds.

So soon as the epidemic died out it was decided to at once establish a permanent hospital for small-pox cases, namely, the one now existing on the line of Moreau street, a place admirably situated and sufficiently convenient to meet all the requirements of such a refuge for persons suffering one of the most loathsome, as well as one of the most contagious, diseases.

The fever hospital now proposed to be built, as also its equipment, will be the property of the city, but the service for the Catholic division will be carried out by the authorities of Notre Dame Hospital, and that for the Protestant division by those of the Montreal General Hospital. For some months past a committee composed of representatives of our board, the Provincial Board, and the Montreal General and Notre Dame Hospitals engaged in the study of the question of a suitable site and suitable plan for the proposed hospital. The results of their labors are contained in two reports, the minutes of their meetings, and the tenders and

plans submitted to our board on the eighth instant. A special committee has been appointed to examine into the work of the above mentioned body and to report to the board of health. There is no doubt that immediate action will be taken to provide permanent hospital accommodation for the fever cases occurring in the city.

DISINFECTION.

The disinfection of houses is done by means of sulphurous acid gas, an operation carried out by an officer specially appointed to attend to this service. Clothing, linen, bedding, etc., when required can be disinfected by means of two steam disinfecting apparatuses under pressure, patented by Geneste & Herscher of Paris, France. One is stationary but the other is movable, which permits of its being utilized in different parts of the city.

QUARANTINE AND PORT PHYSICIAN.

The question of protecting the city from the invasion of disease from abroad has always proved a source of anxiety to the board of health. Time and again representations have been made to the Federal and Provincial Governments to obtain the appointment of a port physician at Montreal, and the appointment of temporary medical inspectors at the boundary lines between the United States and Canada when circumstances should demand such a measure. Yet the city had to do the latter duty up to last year, when the Federal Government, becoming aware of the prevalence of small-pox in the United States, appointed medical inspectors at the different points of entry of the railway lines into Canada.

The government thus showed that they realized their responsibility and determined, as this precedent would tend to show, to take in future the necessary measures to complete the quarantine system. The appointment of a port physician has not yet taken place; but it is no doubt the intention of the government to deal with the matter at an early date. Such a nomination would be welcomed by everybody having the sanitary interests, not only of the city but the whole of Canada at heart, as the examination of vessels at the port of Montreal would prevent the landing of any one afflicted with a contagious disease, the incubation period of which might be so lengthy as to prevent its development and the exhibition of the symptoms necessary to diagnosis until after the time of inspection at the Grosse Isle quarantine station.

VACCINATION.

For many years small-pox caused considerable mortality in Montreal. In 1881 and preceding years the disease was really endemic. From that year up to 1885 no deaths from small-pox were discovered in the city; but in 1885 a serious epidemic broke out extending from April, 1885, into the year 1886, carrying off no less than 3,234 victims during that

period. The population seemed at the time to be unusually susceptible to the disease as, once it entered the city, it spread with increasing and alarming rapidity until it attained its greatest proportions in the month of October, 1885. In that month alone, 1,393 deaths occurred. The vigorous action taken by the authorities was felt in the subsequent month, the number of deaths declining as rapidly as it had risen.

Of course the principal measures adopted to stamp out the malady were vaccination, isolation, and disinfection. The former was very thoroughly carried out.

The most likely reason why the disease propagated so rapidly was that a very large proportion of the population was unvaccinated. For years the enforcing of vaccination was advocated, but the prejudices then very general, especially in certain quarters of the city, rendered it difficult to put the measure into operation. It was not, however, always because the people did not believe in the efficacy of vaccination, but rather on account of a dubious feeling regarding the purity of the vaccine supply.

Another idea that interfered with the generalizing of the practice of vaccination was that when small-pox was prevalent, the operation would simply open the door for the entrance into the system of the contagion of the disease which the prophylactic was intended to prevent.

Many attempts were made to remove those prejudices. Arm to arm vaccination was practised for a time, but while it gave good results so far as successful vaccination was concerned it did not render the prophylactic any the more popular. In those days house to house vaccination was tried, but was declared by the medical health officer in his annual report for 1875 to be a failure, the system not being well received by the people. Three vaccination stations were then established to replace the house to house visiting, but this system proved less satisfactory than the preceding one.

Thus it will be seen that serious efforts were made to ensure the vaccination of the people. At one time the services of twenty-four vaccinators were engaged in this work, and again the expectations of the board were disappointed, as the number of vaccinations was not large, and a very considerable proportion were re-vaccinations.

In 1886 the present system of vaccination was perfected by arrangements being made with different churches to supply the department with lists of the children baptised, foı every name upon which the sum of five cents is paid. These lists are placed in the hand of the vaccinators, who prepare vaccination certificates based upon them, that are served by a special officer upon the parents, who are required to have them signed by a duly qualified medical practitioner after the performance of the operation of vaccination, or else accept the services of the public vaccinator.

The certificate is issued in conformity with the provisions of statute 24 Victoria, chapter 24. Upon the back of the certificate the offices of the public vaccinators are indicated, and the hours at which their services

may be had there. This of course is a complement to the house to house visitation daily carried out by the vaccinators.

The system has been attended with marked success and is becoming daily more popular.

MILK INSPECTION.

On the fifth of April, 1889, a milk inspector was appointed by the board of health, whose authority was based upon certain provisions of By-law 105. Time and again in the annual reports of the medical health officer attention had been drawn to the necessity of such an inspection, but it was only after years of waiting and urging that the step was finally decided upon. The terms adulterated, unwholesome, or diluted employed in this by-law were declared by the judge of the Recorder's court to necessitate ocular evidence on the part of the witnesses of the prosecution in order that the court could condemn the defendant for having contravened the law. In 1890, By-law No. 187 was adopted which fixed the standard of quality of the milk, as follows: 3% butter fat, 12% total solids, and a specific gravity of 1029 to 1033 at temperature of 60 Fahrenheit.

The work of the inspection resulted in greatly improved quality of the city milk supply; but constant supervision and frequent prosecutions are needed to keep the quality up to the standard. In Montreal more than in most other cities, care has to be taken to ensure a good quality of milk, as it forms the main aliment of the very large infantile population which our high birth rate has produced.

The necessity for a constant and strict supervision over this important article of diet was shown by the fact that during the short period which elapsed between the resignation of the first inspector and the appointment of a temporary successor in certain cases the samples taken, upon being tested, gave less than one-half per cent. of butter fat. The two milk and dairy inspectors recently appointed are qualified veterinary surgeons. The special reason for the appointment of these two officers was not only to make certain that the milk supply should be up to the standard but also to prevent, as far as possible, the introduction of any disease capable of affecting the quality of the milk or transmitting disease through its medium.

THE MEAT SUPPLY.

The abattoirs were established only after much agitation and after many difficulties had been surmounted. Hitherto, that is to say previous to 1881, private slaughter houses infested every part of the city, and constituted centres from which the most offensive and dangerous exhalations emanated. The structures of those shambles were of a very primitive description, outhouses of any kind serving the purpose, and they were a constant source of trouble to the department by reason of the filthy condition in which the most of them were kept. In 1875 there

were 85 butcheries within the city limits, requiring the constant supervision of the health inspectors.

The establishments of the present abattoirs under the control of two separate companies relieved the city of a very great and troublesome nuisance although it was some time before private slaughtering in hidden places was effectually stopped.

The creation and operation of the abattoirs did not, however, altogether relieve the health authorities from further trouble so far as the source of our meat supply is concerned, as for years those establishments have had to be closely watched and repeated efforts made to compel those controlling the establishments to keep them in such a state as to prevent the quality of the meat from being impaired and to prevent any annoyance in the neighborhood in which they are located, through offensive exhalations or the like.

During the last cholera scare, the advisory board composed of prominent medical men visited those establishments and discovered defects in the materials used in the constitution of some of the departments and suggested the means of remedying them. They also suggested certain improvements in the manner of handling and keeping the meat and pointed out the necessity of the speedy removal of the offal. These suggestions were ordered to be transmitted to the Montreal Union Abattoir Company, who now have entire control of both abattoirs with a notice to carry out the recommendations as soon as possible. This action had the effect of greatly improving the condition and internal administration of the abattoirs.

The eastern abattoir is situated close to the outskirts of the city in that portion called Hochelaga ward. All the necessary accommodation for the cattle is provided, and the slaughter and rendering departments, as well as that in which the meat is kept and cooled, are quite commodious.

The western abattoir, which, as its name implies, is situated to the west of the city in the municipality of St. Henri, is equally well provided with space and all that is necessary for the care of the cattle, their slaughter, and the keeping of the meat before its being sent into the city.

Each abattoir is under the surveillance of a meat inspector, who not only inspects the cattle destined for slaughter, and the meat after the killing, but also keeps a watch over the general sanitary condition of the abattoir and its dependencies under his supervision.

These establishments, destined to ensure a wholesome supply of meat to the city of Montreal, have not fully realized the expectations at first entertained of them, for, unfortunately, it has been found to be impossible up to the present to obtain from the provincial legislature authority to prevent any meat that has not passed through the abattoirs from being offered for sale in the city as human food. An attempt was made some years ago to carry out a system of stamping of meat, it being thought feasible to thus put a stop to the selling, in the city, of meat from outside municipalities and from the country, which had not undergone official

inspection. But the attempt failed and was completely abandoned. A year or so ago it seemed to some that if no power existed to carry out a complete system of stamping and preventing the sale of uninspected meat, at least some advantage might be gained by a voluntary system which the butchers might avail themselves of as they pleased, the advantage suggested for those having their meat stamped being that the public would be more likely to purchase a food which showed evidence of having been declared by proper authority to be wholesome, instead of buying meat which offered no guarantee as to whether or not it was diseased. But this plan met little or no favor and was finally dropped.

It appears that the reason the legislature is adverse to granting the city full power to carry out a system of stamping, is that it would be injurious to farmers who do their own slaughtering, but of course without any official inspection of the animals while alive. The inspection of the meat of animals after slaughter is insufficient, as disease, discoverable before death, may escape detection, however, through the nature of inspection afterwards. The following figures will give an idea of the average number and kind of animals slaughtered every year:

Western abattoir, animals slaughtered during the year 1893,—cattle 10,899, sheep 13,967, calves 4,925, hogs 58,969; total, 88,760. Eastern abattoir,—cattle 19,070, sheep 49,355, calves 13,723, hogs 30,935; total, 113,083.

The confiscations at the abattoirs the same year were as follows:—Western, cattle 77, sheep 210, calves 114, hogs 285; total, 686. Eastern, cattle 6, sheep 10, calves 110, hogs 4; total, 130.

On the whole the abattoirs have been very useful, but, as may be seen, they will not accomplish what they were instituted for unless there is a law to prevent the selling of meat of animals that have not been inspected both before and after killing.

MEAT INSPECTION IN PUBLIC MARKETS AND BUTCHERS' STALLS.

In the city two inspectors daily visit all the markets and private butchers' stalls, their duty being to examine the meat and to seize and confiscate any found unfit for food. Their powers are derived from By-law No. 75, which imposes a penalty of forty dollars or two months imprisonment, at the discretion of the recorder's court, upon delinquents, in case of prosecution. The control of the meat supply in the city is further established by compelling all persons selling meat to obtain a license which must be renewed annually.

Instances in which a butcher has been found slaughtering a small animal or two have occurred, but they are very rare; as also cases in which persons other than those licensed have attempted secretly to sell meat.

The laws enacted and the organization established for the securing of a good and wholesome meat supply, it will therefore be observed, are not yet sufficiently complete to satisfy the requirements of the public health.

ICE SUPPLY.

Each year the authorities have become more and more strict in regulating the collection of ice by the dealers who provide the city with its annual supply. The past season was marked by the decided stand the board of health took in reference to this matter. They sternly refused permission to any person to cut out ice either for domestic or cooling purposes in breweries, etc., elsewhere than in the river St. Lawrence and only in that part of the river south of an imaginary line drawn from the second pier of the Victoria bridge and running eastward at a distance of one thousand feet from the revetment wall on the Montreal side. A strict surveillance was kept up so that no other ice than that taken from this source was allowed into the city.

SANITARY INSPECTION OF THE CITY.

The sanitary police, who are the inspectors of nuisances, are under the immediate direction of the sergeant and carry out the house to house inspection in the city, see to the cleanliness of the yards and lanes, attend to the special complaints concerning nuisances registered in the health department, and perform such other duties as the medical health officer deems fit to direct. The sanitary inspectors pay particular attention to drainage and ventilation; and see that every house and its dependencies is in a satisfactory condition. They also take note of any unvaccinated person in the house, and ascertain whether infectious or contagious disease exists. The officers are on duty from 7:30 o'clock a. m. until 5 p. m., and report three times a day at the department.

The work of general inspection is efficiently performed, but the number of inspectors is inadequate at the present moment and an addition to the staff will be made as soon as our board is provided by the council with the necessary funds which have been asked for by a special report and which there is every reason to hope will be shortly granted.

SANITARY ENGINEER.

The sanitary engineer, whose duty it is to attend to all matters affecting public health which require the services of such an officer, is now, and has been for many months, engaged in the special work of inspection of schools, colleges, factories, etc. This inspection is carried on according to the most advanced methods; the temperature, hygrometric and barometric conditions of the atmosphere being noted as well as the movement of the air which indicates the efficiency of the ventilating arrangements; special measures are also taken to ascertain the proportion of carbonic acid gas in the atmosphere of each apartment visited.

SEWERAGE AND DRAINAGE.

Much attention has been given to the question of the sewerage system. The importance of a contour map was urged for a long time in order to

establish the levels required for the building of both public and private sewers. The laying of sewers in streets before permitting the erection of buildings therein is a measure that has been for a long time demanded. Its importance can readily be realized. We can, however, count upon our civic legislators to see to it that this important matter is attended to without much further delay.

The sewerage system of the city was planned by the deputy city surveyor about the year 1867. This plan forms the basis of the entire sewerage system of Montreal, and though admitted to be an admirable one and eminently suited to the nature and conformation of the site upon which Montreal is built, still the city does not derive all the advantages which this basis of system offers, as many sewers of ancient date, and built in all manner of shapes, sizes, of different materials, and laid at various depths, exist even at the present day, and are connected with the main system. But they are gradually and as rapidly as possible being done away with.

In order to perfect the system, the health board appointed one committee after another to study the question of the ventilation of the sewers and the perfecting of the system in conformity with the general plan. The opinions of the officials having charge of them—competent engineers—as well as the opinions of other experts were had on the subject. Reports were made to the authorities, but up to the present, so far as ventilation is concerned, the sole means is through the gullies and manholes. In the winter time they are interfered with by the snow and ice, and thus render but little service, the ventilation from soil pipes through the roofs of the houses being about the only relief for the extra pressure in the sewers obtainable. To obviate the difficulty, various means have been suggested, none of which have met with the approval of the authorities, who are still giving serious attention to the matter.

The extension of the sewers in accordance with the nature of that part forming the basis of the system has been going on steadily every year, old and defective sewers being replaced by new and suitable ones, and those laid in the new streets are, of course, constructed upon proper principles.

This portion of my paper has been made as concise as possible, as the city surveyor, I understand, has prepared a complete statement upon this important subject, one which has engaged his earnest attention for years.

DRAINS.

The private drains have always been a source of anxiety to the health department. The integrity of the construction of a large number was compromised by incompetent and dishonest workmen, as also the sordidness of many proprietors, who, upon the penny wise and pound foolish policy, built their drains in the cheapest manner possible, with the natural result that defects are found which endanger the health of the

occupants, causing trouble and expense to the owners themselves, as well as constantly demanding the attention of the health department.

The methods in use for the testing of private drains are the smoke and peppermint tests, which are made by officers specially appointed for this work. The new law concerning plumbing and drainage, a considerable portion of which deals with this subject, will enable the authorities to effect greater reforms in the matter of drainage.

PUBLIC BATHS.

The necessity of free public baths in a city like Montreal with many overcrowded quarters and a large working population had challenged the attention of the public for years before the building of the first one in 1874. This bath was placed in the river St. Lawrence in the vicinity of the Molson property. It was found after a time that the position of the St. Mary's bath (as it was called) was a bad one owing to the strength of the current in that part of the river and the agitation of the water caused by passing steamers.

A more suitable place was found on the south side of St. Helen's island for an open bath, which is taken down at the end of every season and put up again at the beginning of summer. It consists of a series of dressing rooms and an area of water fixed by means of booms chained together, beyond which the bathers are not allowed to go.

A west end bath, the lower part of which was a fixture, was established in the Lachine canal near Wellington bridge, but it has been done away with, and another similar to the one at St. Helen's island, located in the St. Lawrence, at a point at the shore above the Victoria bridge.

In July, 1890, a third bath was established, but this time an inland one situated in Hochelaga ward (corner Desery and St. Catherine streets) at a cost of $3,000, exclusive of the value of the land. It consists of a basin sunk in the ground and lined with wood properly caulked. It is enclosed by a fence round which on the inside runs a platform upon which on three sides are rows of dressing compartments; the fourth side of the enclosure consists of buildings containing the office, etc. The bathers are secured from the view of the occupants of the houses in the vicinity by a large canvas cover. The bath proper or basin is ninety-four feet long by twenty-seven feet in width. The bottom is so constructed that the water is at four different depths,—three feet and a half, four feet and four inches, five feet, and six feet.

Each of the three baths is superintended by a competent guardian who has the privilege of renting bathing trunks and other articles for the toilet.

These baths have been well patronized ever since they were established. Last year, a new departure was made in connection with the western bath, through the urgent petition of prominent citizens of the quarter in which it is located, that is to say, the setting apart of certain days and

hours, during which the bath is devoted to the exclusive use of women and girls.

These conveniences have certainly proved a success, and have tended greatly to the health and comfort of hundreds of persons unable otherwise to obtain bathing facilities.

SCAVENGING SERVICE.

At the present time this service is done by the city, and was begun on the 1st of April, 1893. The contract with the last contractor not having proved satisfactory, the city entrusted the work of carrying out the service to the board of health, who at once proceeded to take over at a valuation the plant of the contractor, and formed an organization to carry out the work in a thorough manner.

The method was changed more than once from that of the contract system to the performing of the service by the city itself. This service, although not yet perfected, offers under the new regime every evidence of eventually proving the most desirable method of getting rid of the offal in a manner alike satisfactory to the citizens and to the authorities.

The city has been divided into three districts, from which the removal of refuse takes place twice weekly. In each of these districts there is a place of deposit, where the offal is received to be afterwards destroyed by incineration. At present a small incinerator is working in the western division, but is used only for the destruction of the most offensive parts of the matter received. There is, however, in course of construction, an incinerator built upon the Thackery system, which will be ready shortly.[1]

Should this machine give satisfaction, two others will be built immediately to deal with the refuse in the two other districts. At the eastern depot there is an incinerator which was used for some years, and which last year was refitted at a cost of several hundred dollars, but it is not, even after being repaired and improved, considered useful.

The Thackery incinerator is a modification on the Manlove, Alliot & Co. destructor in use in many towns and cities of England. It cost $39,000, besides certain extras ($7,000) and has a chimney of 185 feet in height. The inventor claims for it, and has given exceptional guarantees that it will destroy within twenty-four hours all the refuse collected in the division in which it is located, and that without danger of annoying the neighborhood by any offensive emanations.

It is to be hoped that all that is claimed for the machine may be realized, and that the health authorities will thus be relieved of a source of constant annoyance and trouble, as well as danger to the public health.

NIGHT-SOIL SERVICE.

The first attempt to systematize the night-soil service was the granting of contracts to four persons, who engaged to remove the contents of the

[1] It is guaranteed to destroy one hundred tons of refuse in twenty-four hours, also bedding, diseased meat, and small animals

cesspits to a place of deposit outside the city limits acquired by the city. Later, Colonel Maude, a gentleman from England, succeeded in establishing a company called the "Montreal Town Manure Company," composed of some of the most prominent business men in the city. They erected expensive works on the eastern outskirts of the municipality, where the fecal matter, through a chemical process, was converted into a fertilizer. But a short time elapsed before it was discovered that there had been a great oversight in not ascertaining whether a profitable market could be had for the output of the establishment. The failure to find such a market resulted in the company's being obliged to liquidate. A company of a somewhat similar nature, entitled "The Montreal Fertilizer Company," then undertook to perform the service, but found themselves obliged to abandon it after a comparatively short trial.

A contractor then again undertook the work. The Macaulay odorless process of cleaning cesspits, in use in Baltimore, Md., was adopted and carried on by different individuals and companies until it fell into the hands of the present contractor. In 1885 the disposal of fecal matter by incineration was decided upon, and an apparatus which the board of health found acceptable was put in operation. The gentleman who is now entrusted with the carrying out of the service secured a new and more effective machine, that has proved more satisfactory than the one hitherto employed. The adoption of the system of incineration, which had been contemplated for some time, was hastened by the stand taken by the outlying municipalities, which refused any longer to permit the depositing of fecal matter within their limits. The last place where such deposits were made was the municipality of Verdun, which engaged in a criminal lawsuit against the contractor, with the result that he was compelled to cease the depositing. The work of removal and the incineration, which is carried on in a municipality situated at a distance of about three miles from the limits of the city, with the permission of the council of the place, has been performed in such a manner as to give rise to no complaints.

REMOVAL OF DEAD ANIMALS.

Many years ago, when a regular service was established for the removal of dead animals, the contractor was paid so much for the carting away of each animal, and in order to prevent fraud by charging more than once for the cartage of the same animal, each carcass, according as it was received at the deposit ground, was mutilated. The disposal was accomplished in the same manner as the contents of the cesspits, namely, by making large pits, casting the animals into them, and covering them first with a layer of quick lime and then with another of earth.

After a time, this system of removal being found unsatisfactory the work was let out by contract for a period of years at a fixed price; which method has been followed ever since, with the exception of certain

occasions, when persons who had seen in very large cities that many parts of dead animals could be utilized with sufficient profit to compensate for the cost of removal, undertook the contract free of charge, but did not remain long without asking for a bonus or a certain annual allowance. At present the disposal is, by the terms of the contract required to be made by incineration, a method that has been found quite satisfactory.

EXPENDITURE.

The sum of money expended annually for sanitary purposes has increased largely in the last twenty years, the amount spent in 1872 being only 13 per cent. per capita of the population, while in 1892 it amounted to 41 cents per capita. A considerable part of the expenditure is for the scavenging service and for the incineration of night soil.

TABLE OF ANNUAL SANITARY EXPENSES IN COMPARISON WITH DEATH RATES.

Years.	Population.	Expenses.	Expense per capita.	Mortality to each 1,000 inhabitants.
1872	120,759	$14,643	13 cents.	37.36
1873	123,715	13,518	11 "	30.03
1874	124,745	21,010	17 "	36.23
1875	129,840	29,670	23 "	33.33
1876	133,000	22,278	16 "	34.26
1877	134,500	21,867	16 "	35.05
1878	135,000	12,208	9 "	30.51
1879	135,000	10,458	8 "	27.43
1880	140,000	15,844	12 "	26.90
1881	143,000	17,704	13 "	27.18
1882	144,000	19,189	14 "	27.12
1883	150,000	28,458	19 "	25.60
1884	162,959	30,562	19 "	26.74
1885	167,501	41,923	25 "	46.71
1886	183,500	177,163	97 "	25.36
1887	189,501	75,500	40 "	27.96
1888	201,743	76,161	38 "	28.86
1889	210,000	80,526	37 "	26.60
1890	216,300	84,736	39 "	24.80
1891	218,268	86,108	39 "	24.24
1892	224,816	92,663	41 "	24.49
1893		69,336		

In matters of sanitation much depends upon the amount of money placed at the disposal of those who govern the Health Department. The results obtained by the board with the comparatively restricted sum of money placed annually at their disposal, have been much beyond what might be reasonably expected. The truth of these remarks is fully borne out by the mortuary statistics, which show a progressive decline in the mortality corresponding closely to the annual increase in the expenditure.

There has been much more money spent in the interests of health than is shown by the figures above mentioned.

Over two hundred thousand dollars having been spent upon permanent sanitary works and the acquisition of lands for the same since 1886, such as the small-pox hospital, land and building, (equipment not being taken into account) $40,000, our three baths about $7,000, acquisition of the scavenging plant $17,000, three sites for incinerators $75,000; the incinerator now being built, $46,000. These accounts have been charged to special accounts and do not appear in our ordinary estimates.

CONCLUSIONS.

The subjects of cemeteries, the morgue, public markets, private butchers' stalls, rendering and hide curing establishments, "*chalets de necessite*" (public water closets), vaccine supply, as well as other important questions might have been treated in this paper, but the time at my disposal has been too short to permit of my referring to them.

In conclusion I would simply state that the foregoing remarks seem to me to clearly show that Montreal may compare favorably with any other city of its population on this continent.

DRAINAGE OF MONTREAL.[1]

By ALFRED BRITTAIN, Member C. S. C. E., Montreal, Canada.

In the following description of the drainage system of the city of Montreal, the general question of the disposal of sewage will not be considered.

The relative merits of irrigation, filtration, and precipitation have been so fully discussed that it is needless to review them here.

The discharge of the general drainage of a large district into its principal water course, may be accepted as most advantageous from every point of view; providing that the interest of public health does not compel its more or less purification before discharge in a crude state.

In this city there is no demand for it at present; should the law at any future date make the purification of the sewage of this district a necessity, the mode of treatment will have to be determined by the requirements of the law. Then the combined system will have to be abandoned, and some separate system introduced.

Starting from the basis that the existing drainage outfalls of this city are satisfactory, I propose to place before this meeting a few facts, to show that in Montreal the combined system is especially advantageous from a hygienic point, but difficult from an engineering point of view, because of the climate and physical outlines of the district.

This city possesses in the river St Lawrence, a cheap and simple means of the disposal of its crude sewage that we are justly entitled to avail ourselves of, like any other natural advantage.

In "The Climate of Canada," published by Dr. Hingston in 1884, we read, page 30:

> They (the great lakes) feed the mighty St. Lawrence which at Montreal, according to the competent authority of John Kennedy, passes down the river at ordinary low water at the rate of 20,000,000 cubic feet per minute; at ordinary high water in May, 35,000,000 cubic feet per minute; at very high water, when the wharves are flooded in the latter part of May, 41,000,000 cubic feet per minute.

The pollution of such a body of water by domestic sewage must be trifling, because taken at sixty gallons per head and ten people to the acre, it would only give seven per cent. of a cubic foot per acre of the built up portion of the water-shed. There are not only acres of this water-shed without a single inhabitant, but many miles.

Although the volume, velocity, and absence of tide in the river above the town of Three Rivers, make the St. Lawrence suitable for receiving the drainage of the towns on its banks, there are conditions of the river that make low-lying districts on its banks costly and exceptionally diffi-

[1] Presented at the Montreal meeting of the Association.

cult to drain. As these conditions apply to the numerous small towns springing up along its banks, they are of more than local importance.

The difficulty I refer to is the semi-annual flooding of the river in January and April, caused by its remaining frozen for longer periods as it approaches its outfall. This difficulty is unavoidable, and common to all great rivers flowing northward. The semi-annual rise varies from say fifteen to twenty-five feet above the mean summer level, and its duration is from three to ten days.

This city is now protected by a dyke from these floods; and to prevent the water passing from the river up the city sewers, the outfalls of the flood-locked districts are carried to points where their connection with the river can be cut off by gates. While these gates are closed the whole of the water usually discharged by gravity through them has to be lifted by pumps.

The area pumped is separated by the Lachine canal into two districts; that situated on the south side of the canal is below the flood level.

Artificial works have enlarged the original area drained by these pumps, but it may be estimated at six hundred acres. An especial committee was appointed in 1870 and plans made for the drainage of this low district. At the suggestion of Alderman McCord, when chairman of the health committee, its drainage by one of the hydro-pneumatic systems was reported upon but no action taken. The discharge of the drainage of this district is still by gravity, and has to be lifted by pumps when the river is at flood.

An examination of the available records shows that the first attempt to organize a sewerage system for this city was in 1854, when a Mr. Lait, civil engineer, under orders from council, submitted a report on the sewerage of the city. This report was not accompanied by a plan. In 1857, City Surveyor John Doyle, by order of council, made a special report on the same subject, accompanying said report with detailed plans and estimates, showing the location and estimated cost of a system of main and intercepting sewers for the city. This report appears to have been the first systematic attempt to grapple with the question.

The council did not adopt the report of Mr. Doyle but limited itself to instructing the city surveyor, from time to time, to proceed with the main drainage of certain districts; and the construction of lateral sewers on the application of proprietors. This system is followed to the present day. In 1875 City Surveyor McQuestin made a special report on the drainage of the city, but no action was taken on it; and further information is only on record attached to reports of the road committee to council.

In the absence of an authorized general sewerage plan accompanied with corresponding by-laws and code of procedure, and of any means for a proper survey for such a work, a rough survey was made in 1871–'73, with aneroids and prismatic compass, of the different watersheds drained by the city of Montreal. Owing to the limited means at

disposal, only odd days taken from more pressing but less necessary work, this survey is imperfect; but it is still the only available means of estimating the areas and natural configuration of the districts drained by the main sewers of the city. City Surveyor Percival W. St. George proposes when he gets the necessary means, to have plans made similar to those required under the "Public Health Act of 1875." (Great Britain.)

Pending such authorized plans and regulations and during the actual practice of the council to order, from time to time, main sewers for given districts, the following principles have been observed in making estimates for such works, viz.:

That main sewers should discharge a rain-fall of two and a half inches in twenty-four hours from the watershed of their districts, and provide an outfall for their tributary laterals at a maximum depth of eleven feet finished grade; a minimum depth of nine feet and a minimum velocity of three feet per second, when running one third full.

In addition to this, provision is made for receiving the domestic sewage present and prospective.

The following is the general basis of calculations for the size of these main sewers:

Annual rainfall and melted snow, taken at forty inches. Prospective population, ten persons per acre. Domestic sewage, sixty gallons per head every twenty-four hours.

The filling up in Montreal of the natural water-courses has rendered very large sewers necessary, because these sewers must receive the water originally conveyed in the natural channels, which channels in most other cities are protected from encroachment or pollution, and are used as overflows to convey the storm water which is in excess of the accommodation provided in main sewers. The absence of these overflows has to be replaced here by increased capacity for discharge in the main sewers and tank capacity in the lateral sewers.

The city of Montreal has about 140 miles of sewers discharging into the river St. Lawrence by five main outfalls.

All sewers are now designed to form part of a combined system, that is to say, to remove all storm and subsoil water with the sewage matter.

The depth of sewers in this city should be such that their crowns be not less than five feet below their surface, so as to admit of gas- and water-pipes passing above them and below the frost line. But it is often necessary to increase this depth to secure proper grade for sewers themselves.

In determining a district sewer, the precise depths are not established further than may secure the proper workings of the tributaries and outfalls.

All sewers are now built with a form and grade to render them self-cleansing, so that flushing is unnecessary.

The minimum depth of an ordinary lateral sewer (3x2) at which it should avoid gas- and water-pipes, must not be less than nine feet, and in exceptional cases where a water-pipe is exposed to frost in passing over a sewer the pipe should be especially protected.

The original main outfalls, four in number, viz.: Mill, Elgin, De Lormier, and Fullum, were provided when the area of the city was 3,600 acres. The city area is now about 5,500 acres, and another main sewer, that of Ruisseau Migeon, has lately been provided.

In addition to these outfalls, there are a few small outlets for lateral sewers that are not affected by flood water.

The entire cost of new sewers is originally paid by the city, but a certain portion, varying in accordance with the by-laws and special exemption granted from time to time at the recommendation of the finance committee, is recoverable by special assessment on the frontage of the properties on either side of the work.

The drainage of private properties from the street alignment to the public sewer is since 1891 built by the road department, but charged to the property drained. The drainage and plumbing in private property is controlled by the board of health and will not be considered here.

Sewers of a less diameter than 3 by 2, built prior to 1875, are not as a rule in good condition, because they are imperfect in grade, depth, workmanship, and material, being shallow with large, loose joints of lime mortar, and are as a rule built with "square" bricks.

There are no authentic details of the design or execution of the sewerage works prior to 1870, and they are upon the whole unsuited to modern requirements, being of imperfect workmanship and material. Although the larger works have been made serviceable the smaller sewers are inaccessible, and should be replaced by new ones.

Sewers are now built in short lengths, as ordered by council, at different periods and at varying prices. They are designed to form part of one continuous whole work, with a minimum velocity of three feet per second when running one third full, and to afford equal accommodation when in position. But the evil of this system of ordering work is that the additional expense of one portion is charged to the properties on either side of that work, although such additional expense may be for the benefit of another portion not included in the assessment or even built at the time.

The principle of assessing the cost of each separate portion of a sewer ordered by council on the properties on either side of that portion naturally causes the property owners to use their influence to cheapen the work opposite their properties. This is done by leaving undone work that will be eventually necessary if the sewer is to be continued at a later date; or by getting it stopped for the time when the cheaper portion is done, and by so doing lead to a great waste of money by rendering it unsuitable for further extension.

I have dwelt somewhat on the question of outfall, because the difficulty

of final disposal of sewage and of the distribution of the whole cost of drainage works appears to be a question over which there has been considerable difference of opinion; when considering the sanitary improvement of the numerous small towns springing up along our lakes and rivers most of which have, to a greater or less extent, the same natural advantages for the disposal of their sewage. The question of the final disposal of sewage can be fairly considered by such an association as yours, uninfluenced by local obligations which too often warp the judgment.

The utility of a sewer to remove the liquid refuse from each one's dwelling is clear to every householder because he sees himself directly benefited. The necessity for removing the surface and the subsoil water originally conveyed along the surface in natural water-courses, which has now to be passed in artificial subterranean channels, is not so apparent. The very nature of its utility for general purposes makes its necessity vague to the individual mind.

The more general in character such a work becomes, the smaller appears the benefit to the individual. Where large bodies of people are congregated, the sanitary works of that district concern the public more than the individual and should be considered from a public point of view in which each individual has his share. This cannot be done when sewers are considered only local improvements and made a local charge on the properties fronting on the works.

It will be seen that the present condition of the sewerage of the city is not the result of an authorized and approved general design, but is evolved from the state of sanitary works in the city existing at the time new work is undertaken and the limited authority and power of dealing with the question. This is a condition of things not uncommon, I think, in most old cities in America, where a city charter of fifty-four years may be considered quite a respectable title to antiquity.

MODERN DIFFICULTIES IN BACTERIOLOGICAL DIAGNOSIS.[1]

By J. G. ADAMS, M. A., M. D., M. R. C. S.,

Professor of Pathology in McGill University, Montreal.

At a time when in the popular estimation bacteriology is showing itself to be of greater and ever greater import in matters not simply of health and disease, but also in the very commercial relationships of every-day life, and when the world in general seems to be becoming rapidly convinced that the microbe is at the bottom of everything; when, in fact, bacteriology has already made an ample apology for its existence, it is, I think, well that occasionally one of us, not from a sceptical spirit, but because of the very strength of his belief in the importance of the science more especially in its relationship to public health, should pause, and should as a bacteriologist point out that matters are not quite so settled, that in fact the science is not quite so surely established as in the opinion of very many it would seem to be.

Taking into account the present status of bacteriology it is wonderful to think that to all intents and purposes the advance of the science has been synchronous with the scientific lifetime of so young a man as I am.

There is scarce one present here but can remember the days of ample doubt as to the pathogenic properties of any of the bacteria; scarce one but can remember how Pasteur's wonderful series of observations upon anthrax and the bacillus of anthrax received but the barest credence.

From that period one saw the days of gradually lessening doubt until Koch's wonderful investigations into the bacillus of tuberculosis made men pass to the other extreme and made them absolutely sure that whether the microbes were discovered or no, specific microbes exist for every febrile disease, and for a great number of non-febrile diseases. And now, at the present time, there is among bacteriologists, among those most deeply read and acquainted with the subject, as it were a backward swing of the pendulum, to a certain extent.

What I mean is that largely through the teaching of the German school of bacteriologists we had, but a few years ago, come to look upon every disease in which a definite microbe had been discovered, as being due to the presence within the organism of some microbe whose characteristics were absolutely sharply-defined. There was, for example, an absolutely specific microbe of cholera, possessing constant properties, constant peculiarities of growth on various media, and constant chemical reactions on the part of its products, with constant development of special ferments. There was a sharply-defined diplococcus of pneumonia, a bacil-

[1]Presented at the Montreal meeting of the association.

lus of typhoid that could not be confounded with any other microbe, and so on with regard to all the important diseases whose germ has been discovered.

Well, I do not wish now to say that this is false, all that I wish to do in this short paper is to impress upon you the advisability of crying "Halt" before we unreservedly stand to this belief. What is more, it is of the greatest importance to the officers of public health that the advisability of deliberating long and carefully should be kept in mind; inasmuch as it is just in relation to some of the most widespread and epidemical microbes that we have at the present moment the greatest difficulty in regard to the exact bacteriological diagnosis. We have passed or are passing from the stage of undoubting belief in the narrow specific characters of pathogenic microbes to a stage of some little doubt and have before us in relation to typhoid, cholera, and diphtheria, not to mention other cases, a series of problems that are as yet unsettled. The right solution of these problems is, from the point of view of the public health officer, of vital importance, but as yet I cannot regard these problems as having been fully solved or nearly solved; and in this view I believe I shall have the support of my fellow-bacteriologists.

Take, for instance, that I may illustrate to you what are the difficulties of the bacteriologist, what is found in connection with typhoid; no one in our days has the slightest doubt as to the cause of that disease; everyone is agreed that it is due essentially to a bacillus, having on the whole well-defined characters, if once we obtain it from the body of a patient in a fairly early stage of the undoubted disease. No one, again, doubts but that typhoid spreads through the water through contamination of the water supply, but now here is the difficulty. If we examine, in the first place, the water supply supposed to be contaminated, in case after case, we may be successful in discovering on the various media of growth colonies which in mode of growth closely correspond to typhoid bacilli composed of individuals which under the microscope are seen to be scarce if at all distinguishable from the standard; or, again, if we examine the stools of the patient supposed to be affected by the disease, there again we may among crowds of colonies presenting but a slight divergence from the characters usually regarded as typical of the bacillus of enteric fever, find some few colonies only distinguishable by the most delicate tests, and the question is, Are these colonies truly those of the typhoid bacillus, or do they represent some closely allied species? Again we may come across cases which clinically vary from the enteric fever of the text-books, and from which nevertheless the typical bacilli can be obtained; other cases varying to no greater extent in which that popular hero of the moment, the bacillus coli communis, is alone obtainable, form in many respects allied to the bacillus of typhoid. For myself I scarcely see how it is possible to arrive at a positive and assured diagnosis in many of these instances. It is true that in the other diseases the point can be settled by experimental inoculation into animals.

In enteric fever, however, unless one is successful in gaining cultures of the microbe direct from the human organisms from a typical case of the disease and injecting the cultures within a very few hours, inoculation into animals is of no effect. Then there is another side to the question.

Suppose that one repeats the series of experiments made by Babes, and carefully examines the peculiarities of the growths obtained from different cases of undoubted typhoid at different periods of the disease, then it is possible by these means to separate out quite a large number of cultures whose general properties, it is true, correspond with those of the typical bacillus typhi of the text-books, but which at the same time in minuter characters differ from the type and from each other to quite the same extent as do the cultures of doubtful import found in supposed contaminated water and in the fæces of suspected cases. I do not mean to say here that in the majority of cases of typhoid one comes across any marked divergences from the type, but in a large number of doubtful cases just in those cases in which an absolute diagnosis is of the highest import it is that one is most likely to have these slight cultural divergences, and the question is, What is the conclusion at which we are to arrive?

Or, take again cholera: every one I suppose is acquainted with Cunningham's remarkable declaration that out of a dozen odd cases of cholera at Calcutta, the home of this disease, he was able to isolate no less than seventeen different spirilla resembling each other on the whole but nevertheless in his belief presenting such clear and constant distinctions that he classed them not as varieties but as species.

Thanks to Professor Welch of Johns Hopkins University I had last year a series of more than half a dozen growths taken from cholera patients who had come from Europe in different boats to the port of New York during the last cholera epidemic. These cultures had been isolated by that able bacteriologist, Dr. Dunham, and certainly each separate case presented some little difference either in rapidity of growth, in amount of pigmentation, in morphological characters of the spirilla separating them off from Koch's type. Case after case might be recorded of these divergences on the part of growths of the cholera spirilla from different quarters, the most noticeable being those recorded by Sanarelli and by Metchnikoff in connection with spirilla taken from various cases in the neighborhood of Paris. The differences between these various growths are as great as are those between Koch's typical spirilla and the spirilla obtained from water in regions where no true cholera was prevalent. Only quite recently, for instance, an epidemic not of cholera but of diarrhœa has been described as occurring at Lisbon in which spirilla closely resembling the true spirillum of cholera have been isolated. It is indeed a matter of peculiar interest to follow Koch's successive publications upon the mode of determination of the cholera spirillum, to see how point after point which previously had been declared by him to be characteristic, has been with the advance of our knowledge given up, or dwelt upon with lessened stress, until now there cannot be said to be one

single peculiarity absolutely characteristic of this microbe, and all that can be advised is to conclude a multitude of small details, by a process of summation, whether a given culture is one of the cholera spirillum or no. Here again what is the conclusion that has to be drawn? How is the health officer at any point of landing to give an absolutely certain bacteriological diagnosis in every case ?

Or again take diphtheria. Here we are introduced to a slight modification of the problem before us. In the case of diphtheria as in that of suppurative disease, in pyæmia, and of pneumonia, not to mention yet other examples, that we are dealing with a disease due to a microbe of usual pathogenic properties there cannot be the slightest doubt in a typical case, yet it is possible frequently to obtain from the healthy individual, either from the skin or again from the pharynx and mouth, cultures of a form morphologically and biologically undistinguishable. From the virulent microbes of these diseases, from a sore throat, for example, that is not truly diphtherial we may chance to obtain harmless so-called pseudo-diphtherial bacilli, from the skin in the neighborhood of a wound that is healing satisfactorily under carefully aseptic conditions we may gain staphylococci undistinguishable from the staphylococcus *pyogenes albus* of certain cases of well-developed suppuration.

This class of cases, it is true, is not quite so difficult to deal with as those previously mentioned, because while morphologically the saprophytic forms are undistinguishable from the pathogenic, a clear distinction can be gained by experimental inoculation. Animals will take the disease and die in the course of a few hours if inoculated with the pathogenic form, and will resist inoculation or die only after many days if inoculated with the saprophytic form, and yet it must be confessed that from a diagnostic point of view this morphological likeness does introduce the grave difficulty that in order to arrive at a sure diagnosis experimental inoculation must be performed and the bacteriologist must sacrifice a very large number of animals.

Of course I must acknowledge that in speaking thus I am looking and making you look at one aspect of the case, but I am doing this purposely, because unless this aspect be duly contemplated there is a danger of over-confidence of wholesale and uncertain diagnosis being made, and if bacteriology is to be the indispensible adjunct to departments of public health it is urgently necessary that during the next few years while the usefulness of bacteriology in diagnosis is under trial the very greatest care be taken to preclude hasty and incorrect diagnoses. I acknowledge freely, for example, that even without experimental inoculation one is generally able to determine by bacteriological methods whether a given case is or is not one of diphtheria; where the true disease exists there the number of colonies developing at the end of sixteen (16) to twenty (20) hours is relatively enormous; whereas in a case where the bacillus present is not pathogenic the number present upon the surface of the media is very few.

But making all acknowledgments of this nature that can be made, I still believe that what I say is worthy of earnest consideration and constant remembrance on the part of the bacteriologist. Not until some absolute method for distinguishing between various species of bacteria has been elaborated will bacteriologists be able to make an absolute diagnosis in this most important class of doubtful and suspected cases. And for my own part I am inclined to believe that no such method will ever be devised. What I say may, to some at least, appear heretical, nevertheless it is my opinion, and I find in conversation that it is the opinion of most of the bacteriologists whom I have met that with increasing knowledge there is increasing difficulty in sharply defining the various species of bacteria. That this should be so seems to me only natural, for what are bacteria but the very simplest forms of life with which we are acquainted, of shape so simple that throughout the whole of the group we have but a passage from sphere to straight rodlet, to curved rodlet to spirillum, forms without sex, and multiplying in the main by fission or division ?

As Weissmann has remarked with regard to a similar simple form, suppose that an amoeba attached to some small particle in a current gains or protects itself by a thickening of its ectoderm along the surface exposed to the current, then if that amoeba divides, each of those two amoebæ will possess the same characteristic of the slightly thickened ectoderm, and remaining in the same region or under the same conditions all the descendants of this one amoeba must inevitably possess this same characteristic, and in this way a special race of amoebæ must tend to be produced. And so it is with the bacteria, slight alterations of environment must affect, and it has been proved experimentally undoubtedly do affect, the characters of the microbes subjected to those changes, and there is an absence of that beneficial effect of sexual fusion and reproduction to preserve the mean characters of the species. Given any one form of microbe it can only retain its special characters over any long period of time by retaining a like environment, and thus it is that we must expect to find not so much sharply defined species of pathogenic microbes, as fairly well defined groups of pathogenic microbes presenting slight divergencies either in virulence or in morphological characters, or in power of fermentation, or in all of these conditions, the microbe varying to a slight extent according to slight variations in environment.

In cases of disease that are, what is termed, most typical, there we must expect to find and to isolate the microbe most nearly presenting typical characters. In our doubtful and difficult cases we must equally expect to find microbes departing from the type. For these doubtful and aberrant cases in all probability owe their departure from type either to the fact that in them the resistance on the part of the organism has produced a not wholly suitable culture ground for the microbes, and as a consequence of unsuitable environment the microbes have undergone some pathogenic modification, or on the other hand it may be that the microbes have been altered in pathogenic properties previous to their

entry into the organism, and as a consequence of this alteration produce artificial symptoms. And thus it is that it appears to me that the bacteriologist of the future will not so much recognize sharply defined types as he will group together under broad headings varieties or races of bacteria having common characters of growth and similar action upon the organism; while the officer of public health meeting with a member of one of these groups will treat it as suspicious, and will treat a case from which it is isolated, not necessarily as one of clearly defined disease as one worthy of detention and observation; that is to say, in the future it should not be necessary to make an absolute and possibly incorrect diagnosis, but it will be deemed justifiable in cases where the bacteria discovered do not perfectly conform to type to simply state that the case is suspicious, inasmuch as the bacteriological evidence is suspicious.

In fact, to come to the root of the matter we must in many cases be content and prepared to accept divergence from type and to recognize not that such divergence means the presence of a new pathogenic species or variety, causing a separate form of disease, but that it means that there exist groups of races of bacteria, each group of races having broadly the same general mode of growth and conduct, and causing broadly similar symptoms when they gain an entry into the system. Such groups are already partially recognized. Thus, for instance, there are the two closely allied pyogenic staphylococci, there is the already long series of closely allied spirilla producing diarrhœa and choleraic symptoms, the bacilli causing tuberculosis in birds and man respectively, and perhaps best known of all the long chain of minute microbes similar morphologically and similar pathogenically in everything save the extent of their virulence in the different animals, all of them tending to produce a condition of acute septicæmia. We have yet to determine the specific relationship of the various members of these groups. In one case at least it has been proved that what used to be regarded as two distinct species are in reality one and the same. I refer to the streptococcus pyogenes and the streptococcus of erysipelas. Thus the work of the bacteriologist at the present day lies in studying not so much how the various bacteria diverge from one another as how nearly they emerge—in studying the laws governing the relationship of closely allied forms rather than the minutiae of difference.

As to this grouping of bacteria it has seemed to Dr. Wyatt Johnston and to myself, as well as to many other bacteriologists, that the best field for establishing the laws of grouping is to be found in a study of the innumerable slightly varying forms discoverable in ordinary water. From the very wealth of the bacterial flora in water the subject of these bacteria in the water supply is in an absolutely chaotic state, so chaotic that now-a-days one dare scarce name and describe a new species, for fear lest the divergent yet not greatly divergent description given of some other species by some other observer in some other part of the world may after all refer to the species under observation. It has seemed to us that

the only way of getting out of the difficulty is for a series of laboratories to work out each one of the group of microbes; one laboratory, for instance, taking those producing green pigmentation; another the red pigment bacteria; another the bacillus coli communis with all its varieties in contaminated water. By this means working out a very large number of cultures isolated from regions all over the continent, the points of resemblance and of divergence of these cultures will best be determined, and as I say, from the study of a large number of closely allied forms it will be that the laws of grouping can be determined; in fact, only by this method can we establish some guidance to lead us out of our present difficulties. The scheme, it is true, is a large one, and may possibly be found impracticable; nevertheless we deem it worthy to make the attempt to gain the coöperation of others; and we hope that before long with this coöperation of other laboratories throughout America that some good work may be initiated in the direction that I have indicated.

THE EVOLUTIONARY DEVELOPMENTS OF DOMESTIC PLUMBING DURING THE PAST THIRTY-FIVE YEARS.[1]

By J. W. HUGHES, Montreal, Canada.

The annual meetings of the American Public Health Association are the mile stones that mark the progress made on the journey towards the goal which we hope to reach in the not far distant future, or, to modernize the simile, they are the important railway stations where the traveller stops over for rest and recreation, or changes cars and branches off to new routes. As the prudent traveller at such places will look back over the journey passed for the experience to guide him on the road to come, so should we, on occasions of this kind, review the past and see what has been done, with a view to shaping our course in the future so as to save toil and money, for I take it we are travelling for business, not merely for mental diversion or recreation. The faddists, or dilettante sanitarians, of which there are a considerable number, fully represent the latter class.

Taking this view of the question, it seems to me that thirty-five years' daily practice of that calling which brings one into the most intimate relations with all classes of the public who are practically interested in domestic sanitation might enable me to lay before you a few facts of interest, as during the period mentioned have taken place all the great changes in men, methods, and materials that so greatly distinguish modern, up-to-date plumbing from that of thirty odd years ago.

Among shopmates, in my apprenticeship days, were veterans of the craft whose ideas and practice were those of at least fifty years ago. The great distinguishing difference between domestic plumbing in the remote past—as revealed in the writings of classical authors and as shown in the ruins of ancient cities—and modern plumbing arises out of the question of trapping. So far as my knowledge on the subject goes, there is no reliable proof that the ancient craftsmen understood the virtues of the water-seal trap as a perfect safeguard against the entrance of disease germs into buildings, and while the more modern plumber certainly understood something about traps and trappings, and the making and fitting of them was a part of the daily practice of the trade, it is certainly within the past thirty-five years that the full importance of the subject has become known. The development of the modern scientific methods of inquiry into the causes of disease, and for which the medical men deserve the praise, led to this knowledge, and to the intelligence of the modern plumber are we indebted, in a large degree, for those practical methods without which safe plumbing would be an impossibility. Trap

[1] Presented at the Montreal meeting.

syphonage was something unheard of thirty years ago, and yet we know traps must have been rendered inoperative from this cause; anti-syphon devices were unknown, and back-air venting was not thought of.

Within half a mile of this building, about twenty-eight years ago, there occurred something that caused a great deal of discussion among the plumbers of my acquaintance. That was, the then mysterious emptying of a closet trap of its water seal. After a considerable amount of experimenting and consultation, it was proved beyond a doubt that the seal was syphoned out of the trap. The remedy applied was the attaching of a piece of $\frac{3}{8}$-inch pipe to the outlet side of the trap, and carrying it through the wall close to the bath-room window. Contrast that method of protecting the seal with the practice of to-day, calling, by law, for at least a 2-inch back-air vent carried to the outer air, and terminating in such a position as to prevent the possibility of any escaping odors being carried into the building. For years after this—at the time considered a very clever piece of work—was done, I heard nothing of syphonage or trap venting. Then it became the practice to introduce long lines of 1-inch pipe for the purpose. Then followed the use of $1\frac{1}{4}$- and $1\frac{1}{2}$-inch pipes, and finally came the practice of carrying the soil pipe full size through the roof. To-day, not only must the soil pipe be so fitted, but, in addition, special lines of vent pipes are called for. The experiences in Montreal were no different from those in other cities.

Again: thirty years ago many of the city sewers were constructed of wood, and even where there were brick or tile street-sewers the house connections were wooden boxes—in many cases run above the earth—in the cellars, and simply consisting of a bottom and sides, the top being left off for convenience of access. Many a time have I heard a landlord explain to a prospective tenant that the house drains were first class, being constructed of 2-inch plank. The old specifications for the 18- and 24-inch brick-barrel drains, that were only put into buildings of the better class, called for the omission of a brick at intervals of a yard on each side of the drain. This was done to facilitate the removal of subsoil water and keep away damp. The old-timer's great fad was "damp." He fancied if the building was dry, that it must be healthy. When tile drains began to be generally used, it was the custom, and considered good practice, to leave some of the joints open, for the same purpose. Is it any wonder that the plumber was not very particular about trapping? That he used traps at all is to his credit. Contrast the practice of to-day, which calls for all interior drains to be constructed of heavy iron pipe, so put together as to be able to stand the water, smoke, or peppermint test.

Years ago, people expected an odor to come from the drains, and no alarm was felt and instead of rushing for the doctor, sanitary inspector, and plumber when the atmospheric conditions of the dwelling became decidedly thick and malodorous, the thrifty housewife would say "I know there is going to be a change in the weather, the drains smell so;" she

might burn a little coffee or open a window; but there was no panic, the children were not hurried away. Such a visitation was treated the same as a spell of hot, cold, or rainy weather; very disagreeable, but to be endured. As a matter of course, there were exceptions, but what is stated was about the way most intelligent people thought and acted in such cases. To-day any unusual odor is at once pronounced to be that popular "fad" which scientists have as yet failed to find, "sewer gas," and the domestic army, horse, foot, and artillery, is put on active duty to fight the intruder.

Years ago the material in universal use for soil, waste, and water pipes was lead; nearly everything was hand made, of this material; baths, sinks, cisterns. showers, pumps. Then the plumber was rightly named. *To-day*, lead is almost a thing of the past for such purposes. It has been replaced very largely with cast and wrought iron for interior drains, soil and waste pipes, while the water pipes are largely iron, copper, brass, iron lined with glass, and the coming pipe will probably be aluminum.

In no department of the trade has the change been so great as in the fixtures. The old, foul, stinking pan closet is no more seen, except as an interesting relic, to be condemned by the up-to-date sanitarian the moment he sets eyes upon it. In its place are used various kinds of porcelain closets, some of them works of art, and science, in their construction and decoration. The porcelain, iron, enamel, copper, German silver, and fiber bath has replaced the old-time lead. With sinks and other fixtures, it is the same, and so on through a long catalogue.

Again, the change has been most complete in the methods of finishing the wood work in connection with modern plumbing apparatus. The old-time closed seats, panelled laths, concealed pipes, are things of the past. To-day everything must be open to light, air, soap, water, broom, and brush.

Within the past two years, in an old building in this city, I found one of the interior stone privy vaults; it was situated just within the entrance door of a shop, and to all appearance it was a safe vault for the storage of valuables, the wooden door being all there was to distinguish it from such a construction. On opening the door, one speedily became aware of the use to which it was put. It had certainly been slightly modernized by having substituted for the old-fashioned wooden seat, a hopper closet with an apology for a water supply. The closed-in stone vault without drain or ventilation of any kind, contained the filth that it had taken many years to accumulate, and it took a good deal of talk, as well as some official pressure, to convince the owner that such an apparatus was not all that was necessary. It had worked all right for many years, was his argument; why disturb it? Many such abominations were in existence years ago, and it is a question if they were as deadly in their effects as the more cheaply constructed outside privy pits, which still exist in large numbers, and not only contaminate the soil but the atmosphere of a whole neighborhood. The greatest change that has taken place is in

public opinion, and for this, the efforts of such societies as "The American Public Health Association" deserve a large measure of credit. Thirty years ago, we had no health department, no plumbing or drain inspectors, no public scavenging department, no incinerators, no medical health officers, no contagious disease hospitals. Spasmodic efforts were undoubtedly made to clean up during a visitation of some more than usually virulent and fatal disease, but once that had passed, everything of the kind of a general and public nature came to a standstill. People saw no need of keeping up the organization once the enemy they dreaded had disappeared. One thing was in the public favor years ago, and that was the almost entire absence of overcrowding. Population was undoubtedly congested in places, but the immense masses of people congregated in large cities covering immense areas of ground were the exception, not the rule. The two most important questions for the up-to-date sanitarian, are those of overcrowding and ventilation; something has and is being done, but so far it has only been a skirmish of outposts, the masses of the enemy have not been attacked. I cannot close this paper without soliciting the influence of this association in the direction of encouraging the education of more skilled workmen in the plumbing trade, if it is still to be called "plumbing." The plumbers, by the agency of the trade schools, which they have assisted and encouraged, have done something to supply the want caused by the entire disappearance of the old time apprenticeship system, but more is required. The plumber of the past was a skilled mechanic in the true acceptance of the term. The work he was called upon to do in constructing the different fixtures compelled him to be so. To-day, owing to the changes, some of which I have lightly touched upon, he is not required to be so skillful of hand, but his knowledge of the science of his business requires to be infinitely greater. How is he to acquire this information? Those to whom he should look for instruction are entirely lacking in it, and cover their ignorance by generalization, the details being a mystery to them. Special precautions are taken in educating clergymen for the care and protection of our souls; lawyers for the protection of our property, medical men for the cure of our bodies. Comparatively nothing is being done to educate and train a class of men, whose life work it should be to construct honest, safe, and scientific apparatus within our dwellings for the protection and health of our bodies.

The general public does not understand the great need there is of such men. In their opinion, every man who hangs out a sign, bearing the word "plumber" is good enough, if he is only cheap enough. To them the man who honestly does all that his skill and knowledge enable him to do for their protection, and of necessity has a "big bill," is to be avoided, while the ignoramus or dishonest is patronized.

This is all wrong, and the voice of "The American Public Health Association" should be heard on the subject with no uncertain sound. We cannot have public health, without health in the family and individual, and no one can contribute a greater share towards this than the

plumber, or as I believe he will be called in the future the "practical sanitarian."

Which of our great institutions of learning will be the first to afford proper facilities for the training of such men, in head and hand? The training of the hand is no longer considered derogatory to their dignity. Let them go a little further and turn out men trained for this special calling, the responsibilities of which are greater than any I know of, except that of the physician.

PLUMBING IN SANITATION.

By JOHN MITCHELL,

President National Association of Master Plumbers.

The National Association of Master Plumbers sends greeting and trusts that your convention will be a pleasant one, and your deliberations instructive and result beneficially to the health of humanity, the betterment and maintenance of which all of us are zealously striving to accomplish.

Having been delegated to represent the National Association of Master Plumbers at your convention, I deem it essential to summarily outline its history; the demand for reform it has materially assisted in inaugurating; a reiteration of its objects as relating to public health; and the results achieved. In our success we are indebted to many of your members, some of whom are doubtless present.

Through the associated efforts of progressive men of the craft our association was organized twelve years ago. Annual conventions, composed of delegates from filial local associations, have been held regularly, at which papers have been presented and discussions entered into which have proved very helpful to the trade, and resulting in better work have been very beneficial to the public and a monument to our efforts.

Our constitution reads: "This association is organized for sanitary, commercial, and social purposes and has for its special object the advancement of the trade in all the latest discoveries of science appertaining to sanitary laws." Having made this public declaration it behooved us to acquaint ourselves with the principles of sanitation and the best methods of construction to attain the goal. This meant a higher education to the craft.

The task of arousing the dormant energies and encouraging the proficiency of all the members of the craft, both in and out of the association, was a herculean undertaking, but a comparison of the present beautiful sanatory bath room with the not very ancient outhouse, wash-bowl, and pitcher, demonstrates our phenomenal success. The plumbing of a house is now one of the most important branches of the building trade. The transition from the insulatory pan closet and other crude fixtures, the chaotic arrangement of pipes, to the handsome lavatory, closet, and bath, and the systematic arrangement of pipes, traps, and vents, has made it feasible and absolutely safe to place any fixture in a sleeping apartment without danger of the exhalation of mephitic fumes.

It is utterly useless for me to attempt to discuss with you learned gentlemen the septical influence of sulphuretted hydrogen, sulphide of ammonium, and organic matter, commonly known as sewer gas, as a ready conveyer of the materies morbi, or cite cases of the ravages of mediaeval

[1]Presented at the Montreal meeting of the Association

pestilences and mortality statistics to convince you of what, to me, is obviously apparent, that a skillfully executed and scientifically planned drainage system to carry off sewage and prevent the pollution of the atmosphere by noxious effluvium, is a paramount requisite to health. As physicians your efforts are mainly directed to the cure of disease, while ours is that of prevention. Your knowledge is obtained from books couched in technicology, scientific diagnosis, and hospital practice. Our knowledge is obtained through an apprenticeship, averaging five years, first carrying the kit, furnace, and coil of lead pipe all at once, and later, if we are worthy our vocation, a systematic study of mathematics, mechanical drawing, chemistry, and hydraulics. A plumber should not only be able to wipe in a trap, but if it siphons, explain why; for we are practical plumbers and sanitarians only so far as our knowledge of the above extends.

There are some owners and contractors who desire, and are only willing to pay for, a cheap class of work, making it almost impossible for the conscientious plumber to live and execute sanatory work which is the pride of all. That there are a few mercenary tenement owners and plumbers who have no hesitancy in subjecting others, perhaps ignorantly, to typhus, diphtheria, cholera, and pulmonary phthisis by the construction of defective house drains, which afford a congenial nidus for the germs of these maladies, is to be regretted. Without legislation to put a sudden quietus upon the open disregard of hygienic laws, complete safety cannot be obtained. With the continued coöperation of your members, national sanatory legislation is assured, but the delay and the resultant effects imperil more lives than the absence or disregard of the laws regulating the handling of poisoned drugs by the incompetent druggist or his ignorant boy. The trite maxim that "An ounce of prevention is worth a pound of cure," is universally recognized, but too often overlooked by the householder, who, after the triumphant entry of the insidious foe,—the direct cause being his ignorant or criminal neglect—has lost the life of a loved one, finds too late that he has maliciously directed his shafts of alleged wit to the honest "plumber's bill."

Notwithstanding the frightful object lessons inculcated by vicious ventilation and pestiferous sewer gas, people are slow in demanding a cessation. They look to boards of health and the honest work of the plumber for protection against the Protean enemies of health: for our errors of commission or omission we are morally amenable.

As early as 1886 the master plumbers of Maryland drafted and secured the passage of a law providing for a State Board of Commissioners of Practical Plumbing, consisting of three practical plumbers, a member of the state board of health, also a member of the board of health of the city of Baltimore, appointed biennially by the governor, to examine all engaged in the business of plumbing, and issue certificates of competency. Any one found conducting said business without a certificate was subject to a fine of fifty dollars for each offence. The law had been

in vogue but a short time before an incompetent and unlicensed plumber appealed to the courts, claiming that under the constitution he had been deprived of his means of livelihood. The high appellate court of Maryland declared that if any calling was of such a character as to require a special course of training or experience to pursue it with safety to the public, it was eminently proper for the legislature to restrict it.

The legislature of New York enacted a law in 1892 to provide for an examination to determine the fitness of all plumbers in the business. Massachusetts passed a similar statute in 1893. The Honorable Board of Commissioners of the District of Columbia has passed regulations governing plumbing.

It is complimentary to sanatory science that nearly every city in the United States has ordinances regulating the proper running of supply and ventilation pipes, the separate trapping of each fixture, the abolition of the cesspool, etc. The paramount right of such ordinances rests upon the well-recognized maxim, "Salus populi est suprema lex."

It is not necessary to delay action to ascertain whether the plumbing in a building is in proper condition until crape is hung on the door. Annual or semi-annual inspection of old and new buildings should be made compulsory. An advance along this line has been consummated in Chicago, where a semi-annual inspection of all buildings is made under the supervision of the department of health and drainage.

The sanitarians of Ohio, Rhode Island, New Hampshire, and Texas, as well as other states, are working for the passage of sanatory laws. The National Association of Master Plumbers extends thanks to many of your members for past assistance in this commendable work, and now urges that your Association, interested in this momentous question, stamp its approval on the work, and, if consistent, pass a resolution urging your members to exert themselves to the end that pure air and pure water may abound in every home.

THE CONDITION OF THE CHILDREN'S TEETH OF THE PRESENT DAY, AND THE EFFECTS OF DECAYED TEETH ON THE HEALTH OF THE CHILDREN.[1]

By J. C. ADAMS, L. D. S., Toronto.

On this subject very little has been written, but the universally unhealthy condition of the children's teeth is such that silence on the subject would be criminal. Very few parents are aware of the wholesale destruction that is taking place in the permanent teeth of their children, for they only see it in odd individual cases, but if the public could see this condition as I have it would not be long before something was done to prevent it, and I am prepared to show that it can be and therefore should be prevented.

For the past twenty-two years, in addition to caring for the teeth of the children in my regular practice, I have, with the aid of assistants, carried on dental hospital work among children of the poor of Toronto, filling and caring for their teeth free, and in addition to this, have examined the teeth of large numbers of children in our public schools in Canada, and also in some of the American schools. The examination of the teeth of so many thousands of children has given me an exceptional opportunity of noting the condition and the change that is going on in their teeth. I shall not touch upon the cause but confine myself to the condition, as it is found, and the only present practical remedy.

I find that children's teeth decay at a much earlier period than they did formerly, and that the quality of the teeth is so much inferior that unless they are filled as soon as they begin to decay, when the cavities are small, they are soon past all hope of saving. I am speaking of the permanent teeth, not only the six years old molar but also the twelve years old molars and bicuspids. They generally begin to decay within a year or two after being erupted. I have examined the teeth of a large number of adults from fifty to seventy years of age, who, like myself, have first-class sets of teeth, far better now than the teeth of 95 per cent. of the children of to-day at twelve years of age.

This change in the quality of children's teeth is not local, but will be found in 95 per cent. of all the children on this continent, rich and poor alike. I have failed to find any difference. I examined the teeth of a large number of children fresh from England, and found theirs to be in a very bad condition, although there was a much larger percentage of good teeth than among our American children.

I cannot by words picture the unhealthy condition of many of the

[1] Presented at the Montreal meeting of the Association.

children's teeth in the various schools which I have examined. About 1 per cent. to 5 per cent. of the children's teeth were sound, 15 per cent. fairly good, but some needing to be filled, about 50 per cent. of the children had teeth badly decayed, making it very difficult to save them, because the nerve pulps were exposed, and more or less inflamed, while the teeth and mouths of about 30 per cent. of the children were in an exceedingly unhealthy condition, having from six to a dozen and often more of foul, decaying teeth filled with decomposing food, and covered with tartar, which had loosened the gums from around the necks of the teeth.

The loose flaps of gums being so inflamed that they appeared like raw pieces of flesh, other teeth were abscessed and the gums covered with disgusting pus. With a large number of the children it was impossible for them to masticate solid food, and their pale, pinched, half-starved faces told how they were being injured.

In every school that I examined I found children whose permanent teeth had forced the roots of the deciduous teeth out through the alveolar process, and the rough, jagged points had lacerated and worn away the cheeks and lips. I often found from ten to twenty cavities in the permanent teeth of children under twelve years of age. How shall I describe the furred condition of the tongue, and the foul gas emitted from the mouths of such children, which are veritable hotbeds for every species of bacteria, having all the elements necessary for germination, heat, moisture, decomposing food and teeth, with the foul gases arising from them and the stomach? What better conditions could bacteria have? Our health authorities are very careful about having all bones and refuse removed from yards to prevent the air from becoming contaminated, and yet children are compelled every day, by the thousands, to bring their dead decomposing bones to school to contaminate the air of the crowded room and spread disease among the children whose parents have been careful about their teeth. When sickness breaks out in the schools the health officers, at great expense, search the buildings, drains, closets, and yards to find the cause, not suspecting that it is often in the children themselves, whose systems have been weakened by slow poison. Is it not a crime to compel teachers and children who take good care of their teeth to sit in the same room with such children? Remember, these were not poor children, whose parents were not able to get their teeth filled, but children whose parents were in comfortable circumstances, and both willing and able to care for them. But, unfortunately, they were not aware that their children's permanent teeth were in such a condition, but thought that they were their first teeth, and that nature was helping to get rid of them by decay in order that new ones might take their place.

I have also noticed that in a large number of cases the teeth decay without causing acute pain, and thus give no warning of their condition. Who can estimate the amount of poisonous pus and gas passing into the stomach and lungs of such children every twenty-four hours? Is it any

wonder then that children are in a run-down, listless condition, unfit for either play or study, when they are thus slowly poisoned.

Mr. Levi Clark, principal of one of our schools, said that the result of the examinations made in his school was a revelation to him, that he could not see how it was possible for the children to attend school at all with their teeth in such a shocking condition, but he said that they were so ambitious to get their certificates that they would continue at their studies even while suffering great pain and would come to school with their faces swollen and covered with tears, but at last were compelled to go home.

The examination of 25,000 city school children, some in Canada and some in the States, shows that one half of them have suffered so much with ulcerated and abcessed teeth at night that they could not sleep, and one fourth of the children were not able to attend school, some for days and many for weeks, and out of these 25,000 children only 2,200 had their teeth filled this year, though most of them belong to the well-to-do class of our cities. There are more than one hundred thousand permanent teeth in the mouths of the school children in Toronto alone that are going to destruction without any effort on the part of their parents to save them. Who can estimate the unnecessary loss sustained or the suffering endured by these children and the millions of others on this continent who are in like condition? It is a sum that cannot be computed for the effects will not end with the death of the children, for those who will live long enough to marry will hand it down to their children and the world will be populated with nervous dyspeptics. I leave it to you to judge what effect this condition of the children's teeth has on the health of the schools and ask, is it not time that something was done to prevent this fast increasing evil, instead of trying to relieve pain and heal the disease? The true sanitarian by anticipation goes before it saying, halt, you cannot enter here. In England they are waking up in earnest and in many of their training schools are not only examining the teeth of the children, but are employing dentists to fill them. They will not receive applicants to either the civil or postal service who have decayed teeth, and are very strict in their examinations, for they say if their teeth are bad their health will break down, and they will be placed too soon on the pension list. They have also established a dental hospital where the poor can have their teeth cared for.

It is one thing to diagnose a disease; the next is to provide and adopt a remedy. The only remedy at present is to fill the teeth as soon as they commence to decay, long before the nerve pulp has become exposed or the tooth has ached, and while it can be done at one sitting. But just here comes the great difficulty, which doubly increases the seriousness of the evil. The parents are not aware that their children's teeth that are aching are permanent teeth, until they take them to their dentist to have their teeth extracted, and then to their surprise find that they are permanent teeth, and past all hope of being saved. There is not more than one parent in a thousand who knows the difference between the tempo-

rary and permanent teeth. For many years I found it difficult to get the children in the charitable homes to come to me in time to save their teeth. They would only come when their teeth were aching and often they would be past saving, or if they could be saved it would take as much of my assistant's time to fill one bad tooth as it would to fill eight or ten if filled at the right time. So I adopted the plan of going to these schools twice a year to examine their teeth, and those whose teeth needed filling were then sent to me in the Dental Hospital.

This plan has been a great success in these schools, for now we never have any bad teeth to fill, nor any permanent teeth to extract, and the mouths of the children are clean and healthy. The contrast between the condition of the teeth of the children in these schools and those of the well-to-do schools of our city where this system has not been adopted, is sufficient I am sure to convince every fair-minded person that this system is not a fad but an absolute necessity. Let me ask, why should not all parents in the cities and towns on this continent be informed of the condition of their children's teeth, in time to save them, and thus prevent this suffering?

I have given this subject years of careful study, and have failed to find any other remedy equal to this. I would therefore suggest, in the interest of our school children, that in all our cities and towns a dental health inspector should be appointed whose duty it would be to examine the teeth of all children, twice a year (except those children who brought a certificate from their family dentist saying that their teeth were being attended to) and fill out reports to be taken home by the children to their parents, stating the condition of their teeth, and advising them to send their children to their family dentist before their teeth were past saving. As there are large numbers of parents who cannot pay much, and some who cannot pay anything for having their children's teeth attended to, it will be necessary to establish a dental hospital in each of the towns and cities where such children can have their teeth filled and cared for at a nominal fee, simply enough charged to pay the expenses. The whole of this work can be carried on with little or no expense to the city or state, as the dental health inspector can fill both office of inspector and also that of superintendent of the dental hospital; he can spare two hours every morning to make the examinations, or sufficient time to go over the schools twice a year. This would be better than completing the examinations in a few weeks, for it would give the dentists and hospitals time to do the filling without being crowded, or the danger that some of the children would be forgotten who could not be attended to at once.

The examination will not interfere with the work of the school as it will not take more than thirty minutes to examine all the children in the room. I have examined one hundred and fifty children in an hour, and one hundred can be examined with ease. A large number of the school children will go to their family dentists to be examined, which will lessen the work of the inspector and the number that will do so will yearly

increase as they become educated, and thus all the school children, rich and poor alike, will be systematically examined twice a year. I am satisfied that by this plan the expense to the city, if any, will be very small, while the advantage to the rising generation will be incalculable, and will put an end to the present barbarous practice of wrenching out from the delicate jaws of so many children, the permanent teeth that God has given them to masticate their food and to beautify their features.

DENTAL HOSPITAL WORK.

As I have had some years of experience in this work, it may not be considered out of place to give a little of my experience and a few words of advice. Some time ago I sent circulars to the leading cities of the United States and Canada asking what the cities were doing for the preservation of the teeth of the children among the poor. The answer so far received is that the cities are not doing anything, except what is done by the Dental College Infirmary, in cities where there is one, and these are not open all year, nor all day. So the children of the poor are greatly neglected. But if there was a dental college with infirmary connected, in every city and town, they would not meet the needs of these children for two reasons. First, the students who do the work in the infirmary are not willing to spend their time, which is so valuable to them, in working for small children who do not require gold filling, plate or bridge work, and therefore cannot give them any desirable practice, such as they are paying the college for supplying, and can only be obtained by working for adults.

The other reason why the college infirmary will not meet the needs of the children is, that they, as well as their parents, are not willing that the students should practice on them, saying that they are rough and hurt them so much that they would rather let their teeth go without being filled (and no wonder, for they are always handed over to the tender mercies of the freshmen). I made arrangements here in Toronto to fill the teeth free for all the larger children I might send in by card, but I could not get many to go, this being their objection; but they come to the Dental Hospital every day, without the least apparent fear, and almost always without their parents. They know that the work is done entirely for their good, and that makes the difference. I am very careful not to allow a careless, irritable assistant to work for children; for if they get a dread of dental operations through a careless, inexperienced operator, they will never get over it, and their teeth will be neglected all through life. Working for children is not pleasant work, unless the operator is fond of children and has their good at heart, for their mouths are small, and the saliva abundant, and if their teeth are badly decayed they get restless. A dentist that cannot sing, whistle, laugh, tell jokes, give abundant praise, and look good natured when he does not feel like it, will never succeed in a dental hospital for children. The dental hospitals will not be antagonistic to the colleges but will rather aid them for those in

charge of it will only be too glad to send as many of the larger children as the students will be able to work for, and there will be plenty of work for both. I think it will be evident to the minds of every person who has the welfare of the children at heart that a separate hospital is necessary where their interests alone will be considered, particularly when it can be made to pay the greater part of its own expenses in the way I have mentioned. Parents would rather pay a little in the hospital than to have their work done free by irresponsible students. In saying that the hospital would largely pay its own expenses, I am not speaking (unfortunately for myself) from personal experience; for the impression has gone out among the poor of the city that the hospital work I am engaged in is being supported by the city and is entirely free, the result being that the average receipts of the hospital are about two dollars per month toward paying rent, heating, filling material, instruments, assistants' salaries, etc. Professional etiquette prevents me from publicly correcting this impression, or in any way advertising so as to make the hospital pay its own expenses, and the only way I have to reach the poor is through the charities and those working among the poor and by visiting their homes. The public do not know what I am doing, for I have not sent an account of it to the press, or to be entered into the public reports of the different charities I have worked for; as I have never asked for, nor received a dollar of aid from either the city or any citizen, it will be seen I am not making a fortune out of it. If I could have had any means of reaching the five to ten thousand poor children in this city in time to save their teeth, the probability is that this paper would never have been written, for my attention would have been so taken up with them I would have forgotten there were millions of children outside Toronto who were in like condition. Hoping that greater good may come out of what appeared to be an evil, I have written this paper; by which I hope, through this society, which reaches from the Atlantic to the Pacific, and of which I am pleased to be a member, to be able to reach the ears and hearts of men and women in every town and city on this continent, who will have the good of the rising generation so much at heart that they will not rest until they have done something to prevent this fearful amount of unnecessary suffering, and loss of health and life among the children of rich and poor alike. The time is coming when it will be looked upon as a crime not to put the preservation of the teeth within the reach of every poor person, and let me say here that every city not doing so, will have to pay the penalty in this way: There will be a rapid increase in nervous, irritable dyspeptics among that class, who will not be able to give their employers the same energetic labor as they would if strong and healthy, and the number of those who lose all energy and ambition and depend entirely on the public for support, will yearly increase, so that from a financial point of view it will pay to care for the poor. Having seen so much suffering among the children, and feeling the need of something being done to prevent it, is my excuse for writing so long a paper.

QUARANTINE APPLIANCES ILLUSTRATED[1].

By F. MONTIZAMBERT, M. D., F. R. C. S., D. C. L., General Superintendent of Canadian Quarantines.

Dr. Montizambert began by explaining that although the title of his paper would seem to limit him to appliances only, he was sure that, in view of the visit to the Grosse Isle quarantine station that has been arranged for, it would be of general interest if he also showed some views of other parts of buildings at that station, so that when the delegates arrived there they would the more clearly understand the working of the different parts of the system.

By means of lantern slides, a number of illustrations were then shown of the various buildings and appliances, with a more detailed description of each, the appliances for and methods of steam utilization being especially dwelt upon.

After describing the system of bagging the disinfected luggage, the speaker continued:

"It may be within the recollection of some of my hearers that last summer remarks were made in some of the papers about a party of Poles who were stated to have evaded quarantine inspection and disinfection at Quebec. Now it is impossible for immigrants to avoid or evade the quarantine inspection, because no immigrants can arrive by the St. Lawrence except in a ship, and no ship from outside Canada can make customs entry at the port of Quebec or Montreal without exhibiting, as the very first paper called for, its certificate of inspection at and discharge from quarantine. This is under a penalty to the collector of customs or customs officer of $400 and imprisonment for six months for allowing customs entry of any vessel in the absence of the production of a quarantine clearance, in accordance with the requirements of the regulations. And this is not simply an enactment hidden away in the printed regulations and unknown to those who have not occasion to study them, but it is quoted in full upon the face of every quarantine clearance, so that it is being continuously kept under the notice of the pilots, captains, and customs officials. Furthermore, in the case of all passenger vessels, the clearance granted by the quarantine officer is conditional on the landing of the immigrants and their luggage at the disinfection substations at Quebec or Léois at the deep-water termini of the railways. The supervising officer of such disinfection has to count the immigrants as they land, and if he finds the number tallies with that marked on the clearance of the quarantine officer (the whole number on board, or those from infected countries, as at present), and has satisfactory evidence that all their luggage has been landed with them, he shall punch the clearance at

[1]Montreal meeting.

the place marked for that purpose, which shall then alone become valid for customs entry. So you see evasion is impossible, on account of the safeguards with which the Dominion government has surrounded the processes of inspection and disinfection. Intentional removal of evidence of disinfection we cannot of course guard against—thus with those Poles, to whom I referred, who were found at Toronto without their luggage bearing evidence of disinfection. They had been inspected at quarantine, and their luggage had been steam sterilized, and bagged at Quebec. There was the interval between Tuesday morning at seven to the Sunday following, between their leaving Quebec and their being so found at Toronto. During this time they are stated to have undertaken work at Cornwall, and from thence to have been taken on by a "boss" to work in the states. This being so, they would naturally remove all possible traces of recent arrival, so as to evade the alien contract labor law at the frontier.

We inspect, we disinfect, we bag, we warn immigrants to preserve their evidences of disinfection, and we provide against accidental loss of these by the use of a stamped seal and almost unbreakable wire attachment. But we cannot prevent the intentional removal of the bags, once the luggage has been claimed by its owner and removed.

Dr. Montizambert referred to the wish that he like other sanitarians entertained, that the word "quarantine" could be dispensed with. It was founded on an idea which science has outgrown, and its retention causes modern methods to inherit undeservedly the objections rightly urged against the old. The keynote of the old system was prolonged detention; that of the modern system is prompt disinfection.

In conclusion Dr. Montizambert reminded his hearers that there must always be the possibility of exotic disease passing the quarantine barriers in an invisible and unrecognizable stage and condition and first declaring itself in the interioı of the country. This cannot be entirely avoided without such routine detention and disinfection of all vessels, passengers, and merchandise at the ports of arrival, and such consequent interference with trade and commerce as would be quite unjustifiable and impracticable.

Quarantines may be held accountable for dealing with actual cases of infectious diseases, with infected vessels and effects, and those suspected of being infected. But they must not be expected to do the impossible, nor should they be leaned on as an excuse for lessened effort inland. Coast quarantines and inland health organizations must form our double line of defence, or, to borrow an illustration from the game of cricket, the coast quarantine is the wicket-keeper and the health board the long-stop.

But the well equipped and well worked quarantine can, and should, strain out and protect the country from a very large percentage inland of the exotic diseases which threaten it from time to time, and so do a great and very valuable work.

And, concluded the speaker, I think that from what you have heard and seen this evening you will agree with me that the Dominion Government has placed the quarantine service of the St. Lawrence in a condition thoroughly to perform its onerous and important duties, and to be an actual and potent protection to this country.

And as the people of Canada and the United States become more generally acquainted with the manner in which work is really done at our ports, and the safeguards the government has provided to prevent evasion of quarantine inspection and disinfection, there will be an ever increasing confidence in the quarantine service, and ever less and less unnecessary uneasiness and fear for themselves.

INFLUENCE OF INEBRIETY ON PUBLIC HEALTH.[1]

By T. D. CROTHERS, M. D.,
Superintendent Walnut Lodge Hospital, etc., Hartford, Conn.

In this preliminary study I wish to call attention to a very dangerous element to public health, that has not attracted any special attention up to this time. While sources of poison, and the spread of epidemics, and questions of morality, hygiene, and education have been considered in much detail, the influence of a vast army of men and women using spirits to excess, degenerating and retrograding, is practically unknown. From the best statistical reports it may be said that there are at least half a million persons in this country who are literally inebriates. Of this number, fully a hundred thousand, or one fifth, are the chronic degenerates who are arrested for drunkenness and petty crime constantly, in all our large towns and cities. This latter class are grouped with paupers and other dependents, and supposed to occupy the same position and have the same influence. The former class are non-producers and burdens on their relatives and friends. The idea prevails that inebriates everywhere are simply vicious and wilfully use spirits, always having the power to abstain. Higher up, their influence on public health is overlooked and seldom attracts any attention. Lower down it is more apparent, but apparently limited in a degree by law and sanitary police regulations.

All critical examination of the facts of these classes fails to sustain the theories of their presence and influence. Take the chronic inebriate, who appears frequently in the courts charged with intoxication and petty crime, as a study. The only purpose of his life is to procure spirits. He sacrifices every consideration of living and relation to society for this one aim, and persists in becoming more degenerate and unfit. His downward march drags with him associates and surroundings and creates centres of contagion, that breed idleness, trampism, pauperism, which ends in criminality, insanity, idiocy, and hopeless degeneracy. The chronic inebriate may be called a suicidal maniac, who not only destroys himself but infects others, and transmits a similar tide of degeneration to the next generation. Wherever he goes the saloon springs up and the slum classes gather, and breeding places of disease, both physical and mental, follow. This is proven by the statistics of courts, asylums, and hospitals, of all kinds, where alcoholic causation appears so prominent. The presence of this class in any community is marked by pauperism, petty crime, and degeneration; epidemic diseases find congenial soil and lodgement in these centres and begin in such cases, spreading outwards

[1] Read at the Montreal meeting.

in all directions. A number of instances are on record of yellow and typhus fevers, of cholera, diphtheria, and other lesser epidemics, beginning in chronic inebriates and attaining great proportions and virulence. In the advance report of Dr. Wright, labor commissioner of the United States, the presence of this class is indicated by the proportion of saloons to the population in the slum districts.

In New York city it was one to every 127; in Baltimore, one to every 105; in Chicago, one to every 127; while in these cities at large the number of people to every saloon was more than twice this proportion. Thus the chronic inebriate is the saloon supporter, and wherever the saloons are most numerous he will be found, going down through all the successive stages to mental and physical death. If these persons were confined to beds in hospitals and homes, some estimate could be made of their influence on the health and vigor of the community. If their real condition was recognized, and practical measures applied to isolate and treat them, we could understand in some measure their influence on public health. But, in reality, they are unknown, misunderstood, and treated as having no influence, only in a very general way, on the health of the community. Scattered as they are in every town and city of the country, and each one passing down through a continuous dissolution, marked by infection, contagion, and destruction, the influence on public health is most disastrous and far reaching. The paupers, tramps, idiots, defectives, and incapables are all closely allied, and direct descendants of inebriates or advanced stages of this same disorder.

Take any common case as an illustration. A man, previously a producer and self-supporting, becomes a chronic inebriate. He has a wife and family, who are driven to pauperism, want, and destitution. His time is spent in saloons and jails, and finally he dies in the prison or almshouse, or is found dead in conditions that become the subject of legal investigation. During this period he has been a menace, and in opposition to every normal condition of life and living. He has antagonized labor, encouraged idleness, fostered the saloon, and lived in defiance of moral and physical law. Each year of his life he has receded farther from all truth, honor, and manhood, and lower in the scale of animal life. The contagion of his example and influence has been lower and lower. His family have been destroyed and crippled, and thrown out as burdens on others. An unknown tide of heredity has been transmitted that may destroy the generation to come, and, at least, will always incapacitate it to a greater or less extent. These are the facts occurring in the history of over a hundred thousand persons in this country to-day. The effect on public health, the losses to society, the burdens on the taxpayers, the perils to life, to property, the increase of sickness and mortality, and the obstacles to progress, growth, and development require no detailed description; they are apparent to every observer. The pecuniary burdens which this class entail on the community are still more startling.

Outside of the loss from illness, the cost of arrest, conviction, and punishment in jail or prison, the board in insane asylums and almshouses, and the burden of support for their families would exceed, according to the best estimates, twenty million dollars a year, or a sum greater than that required to support the standing army of the United States, or pay the expense of all the state governments, or sustain and care for the Indians. The fact is still more startling that the efforts to control this class are absolutely futile and without practical results. Year after year the childish methods of arrest, conviction, and sentence go on over and over again. The victims are made worse and unconsciously trained and precipitated to lower and more degenerate states of life and living. In reality the present methods of dealing with the chronic inebriates are opposed by all teaching of science, and all sanitary rules that would apply practical remedies at the source of the disease, and along the lines of natural laws.

There is another class of inebriates whose influence on public health is becoming more and more prominent every year. They are the continuous or occasional drinkers, persons who are often producers and who have drink paroxysms at intervals. They extend from the ranks of the laborers up to the very wealthy, and include the politician, the speculator, and the sporting men of all grades. From this class come the agitators, the anarchists, the strikers, the wild reformers, who are practical revolutionists. The inebriate politician and speculator are always storm centres to society and public health. Their uncertain, reckless course of conduct is a disturbing element that antagonizes all sanitary rules of living. They both demoralize and degrade the work they come in contact with, and fall to lower and lower grades of living. Some illustrative cases will be recognized as familiar to all. John Jones, an inebriate, came into possession of a large manufactory at the death of his father. As the result of his foolish, bad management, a strike of the operatives occurred and in two years the mill was burned down and the business permanently broken up. A large number of persons were precipitated into abject poverty and distress. Thus a prosperous New England village was destroyed. Victims of this disaster are yet in the almshouse of that county, and the influence on public health and society has made a permanent impression on the community. After the war, a soldier and inebriate opened a drinking hotel and saloon in a prosperous farming township in New York State. He died by suicide ten years later, leaving two sons who continued the business. In 1893 one of these sons was serving a life sentence in prison for manslaughter, committed during a drunken bout at his home; the other is an imbecile. Four persons from that town are in the insane asylum, six are in the county almshouse, all indirectly the result of the inebriety of this soldier and his family and saloon. The contagion of saloons and inebriates is within the observation of everyone, and innumerable examples of the dangerous infection, which comes both directly and indirectly from this source, are traceable in many communities.

Yet, strange to say, the public have not recognized this as a source of danger to the community, to society, or to public health. Even to-day, the public tolerates and overlooks the evils and losses which come from inebriates in positions of trust, responsibility, and influence.

Corporations and capital are far in advance of the public in this matter. Inebriates and moderate drinkers are regarded with increasing suspicion. Their capacity and influence are doubted. The use of spirits is considered more or less dangerous, in all positions of trust and confidence. Railroads, manufactories, merchants, brokers, and capital, in all positions, are calling for temperate men to do their work. Even the liquor dealers require abstainers, as more trustworthy. This is extending and growing more imperative every year. Railroads are refusing to employ any one, no matter how skilled, if his history as a total abstainer is not clear. Thus inebriates and moderate drinkers are regarded by capital as dangerous, as sources of peril to the selfish interests of trade, and to everything that makes stability and law and order in all communities. Even the mercantile agencies rate capital and capacity low, where it is controlled by moderate drinkers, or inebriates. Life insurance companies realize their greatest peril in carrying risks on these classes. This is no sentiment, or the result of any theoretical opinions, but is the conclusion of incontestible facts, that cannot be ignored. Outside and beyond the moral and political agitations gathering about this subject there is a sanitary and scientific side which demands recognition. The inebriety of all degrees, from the pauper up to the millionaire, affects the sanitary, social, and pecuniary interests of every one. All our efforts to lessen mortality, diminish sickness, stamp out epidemics, promote the growth and welfare of the community, are most seriously affected by this element. Recently an object lesson of its baneful influence on the public, has been seen in the riots and strikes, and anarchist tendencies of the lower classes. In all these cases the inebriate and the saloon have been the prominent source of these troubles. The evils and direct influence from heredity springing from these classes, open up a field of great magnitude, and scientific importance that another century must study and discuss. The immediate problem for us as sanitarians and scientists to-day is the recognition and scientific study of these classes and their influence on the health of the public. First of all we want to know the causes and conditions from which they spring ; what favoring soils stimulate and foster their growth ; how they spread and influence the sanitary conditions of communities and individuals. If it is true that a half a million of these persons exist in our country, and each one is a center of continuous degeneration and dissolution, not only to himself, but to others, it would seem that no other topic could be of more practical value. In any event, we can say that in a very large number of all the households of this country, the question of what shall we do, how shall we treat the inebriate, is a vital one. It touches our home interests in many ways, and demands an answer, above all morals, sentiment, and

theory. This topic is not new to medical science. For two thousand years the disease of inebriety and its curability has been discussed and defended. Within the past quarter of a century a medical society for the study and cure of inebriety has been quietly at work in this country gathering facts and statistics. Ten years ago a similar society started in England, doing the same work. Both of these societies have laid the foundation of a literature in books, journals, and papers, that give promise of an entire new field of medical study in the future.

The relation of inebriety to the public health and sanitation has been outlined in many ways, and certain great facts have been ascertained. The disease of these armies of inebriates has been established; some general causes have been pointed out and lines of treatment indicated. A summary of the conclusions of experts and students on the question of treatment will, at least, be suggestive. Inebriates of the lower and pauper class should come under legal restraint, the same as criminals and violators of law and order. They should be regarded as dangerous, and sources of infection to be quarantined, housed and protected.

Every city and town should have a work-house, hospital, or a large farm, managed with military discipline, where these persons can be organized, disciplined, and employed. The sentence should be indeterminate, and apparent recovery be rewarded by liberty on parole. These cases should work every day, in some way for the best interests of all, at farm work, on the public roads, in some light, in-door, factory work, and thus be occupied much of the time. They should have medical care and training, the same as children, subject to rewards and punishments; duties that are enforced and obligations that are realized, with physical and mental sanitation. These means would turn this vast army of dependents and parasites on the community to self-supporters, and check the sources of many evils. To a very large extent this army of inebriates can be successfully housed and organized into self-supporting farm colonies. It has been demonstrated in many ways on a small scale. Beyond the mere sanitary, economical housing of these cases, comes the fact that a certain unknown number would be permanently restored, and go back to the ranks as self-supporting and producers. A farm colony hospital for this class would not require an expensive plant in buildings and surroundings, but would require expert managers and exact military care and management.

Compared with the present fatal and expensive methods of repeated short sentences in jails and fines, that always react fatally on the family as well as on the man, this treatment would be a century in advance. Private enterprise would be stimulated to provide similar places for the less chronic and more curable cases. Persons who have property and friends who could pay for their detention, could be sent to these less public places, and have the same military and medical care, the same enforced duties and regulated surroundings. In all exact legal restraint shall be exercised. The law should recognize that all inebriates

have forfeited their right to liberty, and become dangerous to society and the well-being of the community; also that inebriety is a disease, dangerous alike to the individual and the community in which he lives, a disease that, like small-pox, requires to be quarantined and have special medical care and surroundings; that the community needs protection as well as the individual; that the suicidal mania of half a million inebriates in this country, who persist in destroying themselves by the toxic use of spirits, should and can be checked.

The teachings of scientific study in this field, point out clearly the fact that this ever increasing army of acute and chronic inebriates can be halted, housed, disbanded, and turned into the ranks of producers. When this is done, some of the greatest problems of public health will practically be solved and disappear. Then, the facts of its influence on sanitation, on progress, growth, and civilization, will be seen, and the wonderment will be, why it was not recognized long before. Our duty today is, to demand the facts of the origin, growth, and development of inebriety, and the conditions and environment that favor or retard the growth. To demand that the inebriate should be treated the same as any other physical defect; that his conduct and condition should be studied from a physical standpoint; that the means and methods of treatment should be along the lines of natural laws above all theory.

Some of the facts I wish to make most prominent, are these:

1. The influence of inebriety on public health is of far greater magnitude and more closely associated with the various sanitary problems of the day than is realized at present.

2. Our present conception of the extent, nature, and character of inebriety is erroneous and based on theories which are wrong. Our methods of dealing with inebriates are most disastrous and fatal in not only destroying the victim, but perpetuating the evil we seek to lesson.

3. These cases must be recognized as diseased, and be housed in farm colonies, under military care and medical treatment. They must be organized, employed, and placed in exact hygienic surroundings, and made self-supporting. They can be utilized, made to earn their living, some of them permanently restored, and all be quarantined and protected, and the community saved from the contagion of their presence.

4. This can be done when the facts of their origin, growth, and condition are understood. The present duty is careful medical study of these classes, and full recognition of their needs and requirements. Public sentiment should be built up to sustain rational means and measures in their treatment.

5. The sanitary problems that confront our civilization are very closely associated with the inebriate class. One of the central sources of peril to public health is inebriety. This is one fountain head that must be closed and corrected to break up some of the evils lower down.

DISCUSSION.

Dr. Albert L. Gihon.—I desire to ask the writer of the paper a question. The paper is supposed to deal with the sanitary consideration of inebriety, but I think the writer used the expression inebriates and moderate drinkers, and after that abstainers. Are we to understand that this paper is a covert attempt to argue against the use of alcoholic liquors of any sort? If it is, I do not think it should go on record as a communication to the American Public Health Association, but it had better go to the American Temperance Association.

Dr. Crothers.—I used the term moderate drinkers. It is not new; the class the doctor refers to, moderate drinkers, called sometimes inebriates, are men who drink continuously; men who drink to excess. It includes all persons who drink to excess.

Dr. Gihon.—An occasional drinker, what does that mean?

Dr. Crothers.—Occasional drinkers are spasmodic and periodical drinkers. They have paroxysms of drink.

Dr. A. R. Reynolds.—I think the doctor intends to use the word inebriety to include that class of people who abuse drinking rather than those who use it moderately.

Dr. Crothers.—I may say in explanation of the term moderate drinkers, that it is only used to express a class of men who drink continuously, say five or six times a day.

INFECTION BY THE BACILLUS PYOCYANEUS A CAUSE OF INFANTILE MORTALITY.[1]

By E. P. WILLIAMS, M. D., and KENNETH CAMERON, B. A., M. D., from the Molson Pathological Laboratory, McGill University, Montreal.

In the days of pre-antiseptic surgery, a condition not uncommonly observed in hospitals was a blue discoloration of the dressings associated with a peculiar odor. The cause of these phenomena was a matter of speculation until Fordos, in 1869, pointed out that the coloration was due to a blue crystalline pigment which he called pyocyanine, but it remained for Gessard to demonstrate, thirteen years later, that this pigment was the product of a definite organism—the bacillus pyocyaneus. This micro-organism is a very short mobile bacillus, measuring 1 to 1.5 per mm. in length and 0.6 mm. in breadth, though sometimes it is no longer than it is broad and may be readily mistaken for a micrococcus.

It can be studied with the greatest ease, as it grows with great rapidity in all ordinary culture media at the body temperature, producing a characteristic green coloration and certain definite chemical reactions.

The effects of this bacillus and its products have been extensively studied by several observers, notably Charrin, Ruffer, and Babinsky. Charrin found that he could by subcutaneous or intravenous injections of cultures produce in rabbits a very characteristic disease, ending fatally, the symptoms and duration of the illness varying with the quantity and quality of the virus introduced. If a large dose—0.5 to 1 c. c.—be injected into the vein of a rabbit's ear, the animal will die in from twelve to twenty-four hours, the symptoms being loss of appetite, elevation of temperature followed by a fall before death, diarrhoea, albuminuria, drowsiness increasing to coma, and sometimes convulsions.

The post-mortem examination of the organs shows marked enteritis, and hemorrhages into the caecum and kidneys, or on the surfaces of any of the abdominal or thoracic viscera. The specific bacillus may be demonstrated in the substance of the organs by microscopic examination and by cultures.

If, on the other hand, small repeated doses are given subcutaneously, a different train of symptoms appears. The disease becomes more or less chronic. Besides the albuminuria, diarrhoea, and fever, there is rapid emaciation, cutaneous hemorrhages, and a peculiar form of spastic paralysis affecting usually the hind legs only, the thighs are flexed upon the pelvis and the legs upon the thighs, which condition relaxes under chloroform; handling the limbs gives the animal pain; the muscles do not waste nor do they lose their electrical reaction. A few hours before

[1] Presented at the Montreal meeting of the Association.

death the paralysis becomes general. The post-mortem examination shows hemorrhagic infarcts into all the organs, and the specific organism may be easily demonstrated. The six cardinal symptoms of this experimental disease—this pyocyanic disease of Charrin—are fever, albuminuria, paralysis, hemorrhages, diarrhoea, and wasting.

Though this organism is so very definitely pathogenic to rabbits, it has been until recently regarded as a curiosity without any influence upon human pathology. It has been frequently found associated with other septic micro-organisms in the pus of wounds, abscesses, and discharges from suppurating cavities, and has not seemed to exert any deleterious influence upon the general health, or locally upon the skin. In fact, it is said that the old surgeons looked upon blue pus on their dressings as rather a favorable sign. The bacillus has also been cultivated from the healthy, intact, but not clean skin, especially from those parts that are warm and moist.

It was not until 1889 that this bacillus was found to produce a definite general infection in young children. Ehlers, of Copenhagen, reported cases in two children—brother and sister, respectively eleven and twelve years old—who suffered from fever, profuse diarrhoea, enlargement of the spleen, mental depression, and prostration. They were thought to have either typhoid fever or cerebro-spinal meningitis. About the twelfth day, an eruption of papules occurred on the surface of the body and limbs, especially anteriorly. These soon became pustular and bullous, the bullae containing a blue fluid, and ulcers were formed with their borders hard and pigmented by hemorrhages. One of these children died, and from the pustules, spleen, blood, etc., the bacillus pyocyaneus alone was obtained.

Neumann, of Berlin, reports a case in a child thirteen days old, which had symptoms of enteritis with jaundice, petechiae, and hemorrhages from the mucous surfaces. He found, after death, ecchymoses into the skin and into the mucous membrane of the intestines, a swollen spleen, and parenchymatous degeneration of the kidneys. From the liver and spleen he isolated the bacillus pyocyaneus (B).

Oettinger[1] reports a case which, though it does not have a direct bearing upon our subject, shows that the bacillus pyocyaneus may produce a general infection in one worn out with prolonged illness. A young man of twenty-one, convalescent from typhoid fever, had during the fever a small suppurating sore on his right index finger. On the thirtieth day the temperature rose suddenly to 39.4°, accompanied by an eruption of bullae about the groins and scrotum. These bullae contained an opalescent violet fluid, the edges were thickened and injected, and many coalesced, broke down, and formed ulcers. From them the bacillus pyocyaneus was isolated.

Such is the scanty record of the subject, and we now present the fol-

[1] In La Semaine Medicale, October, 1890.

lowing cases which have come under our notice during the past six months, in our service at the Montreal Foundling and Infant Nursery:

Case I. C. E. was admitted on November 17, with his mother, a Swedish woman in good health. He was entirely breast fed and gained steadily until the twenty-second week of age, when he became restless and ill and began to lose weight, for which no cause could be assigned. After five weeks, diarrhœa with green stools set in accompanied by fever (99° to 100°), abdominal pain and tenderness but no tympanites. About the 1st of May a group of half a dozen purple papules 3 to 7 mm. in diameter, appeared on the abdomen on each side, midway between the umbilicus and the flank. The child was then in a low, depressed state. During the following fortnight many more papules appeared, extending up and down from the original groups and across the hypogastrium in the form of an irregular horseshoe; still later many of these became confluent and others appeared on the abdomen and chest. The depression became extreme and the loose green stools continued. The lower limbs were rigid, the legs were flexed upon the thighs and the thighs upon the abdomen, and any attempt to straighten them out caused the child pain. The papules now for the first time were seen on the thighs and shoulders. On the 22d, there was a very profuse epistaxis. On the 25th, bleeding occurred from between the toes and from papules on the right thigh and back. The child became comatose and died on May 27, two months from the onset of the illness, having lost one quarter of its whole weight during that time.

At the autopsy performed shortly after death all the organs were seen to be pale except the spleen which was of a deep crimson color. The kidneys were large and several hemorrhagic infarcts were observed on the surface.

Microscopic examination showed the capillaries everywhere crowded with bacilli which here and there formed emboli.

The bacillus cultures were made with the following results:

In beef broth (1 per cent. peptone and 0.5 per cent. sodium chloride) kept in the incubator at 37°, a greyish film appears on the surface in twenty-four hours.

Upon shaking, by which we expose the broth to the action of oxygen, a bluish green color appears which later turns to a grass green. On standing the color fades but for some days will reappear on shaking. In old tubes the color is a deep reddish brown.

On gelatine (1 per cent. peptone and 0.5 per cent. sodium chloride) a thin greyish film appears on the surface which rapidly liquefies the upper portion of the median. As the growth sinks, liquefaction continues. The color produced is the same as that on beef broth.

On agar-agar (1 per cent. peptone, 1 per cent. glycerin and 0.5 per cent. sodium chloride) the growth is moist, spreads rapidly along the needle track and radiates over the surface of the medium which soon becomes a fluorescent light green usually with a slight bluish tinge at the

edges of the growth. Later the green deepens, and finally becomes a nut brown.

On agar-agar (without glycerine), there is more liquefaction of the medium at first; soon the surface of the growth becomes dry, and shows a peculiar metallic luster.

On egg albumen, a creamy bluish white growth spreads rapidly along the needle track. The egg becomes first a bluish green, while the liquid formed is an opalescent, cloudy blue. Later the egg becomes a dark blue, and the liquid is a dark green. On shaking, the egg partially dissolves, and the mixture is of a dirty bluish green color.

(On plain egg, the results are almost similar.)

On potato, a growth appears in fifteen hours, and spreads from the needle track over the surface. It is moist and fawn, colored while the potato becomes a bright green. In old tubes, the whole becomes a dark, dirty green.

The presence of the bacillus may be readily demonstrated where prepared culture media are not at hand.

A quantity of the child's urine collected upon a bit of absorbent cotton rendered nearly neutral by the addition of sodium carbonate placed in a tube and kept in a warm place will, if the bacillus be present, in less than twenty-four hours show a greenish tinge at the surface and become quite green if shaken. In the same way any normal urine may be sterilized, neutralized by sodium carbonate, and used as a medium.

The blue crystals of pyocyanine are readily obtained by adding chloroform to the alkaline fluid cultures and evaporating slowly to dryness.

If to any of these cultures chloroform is added it assumes a beautiful Cambridge blue color. On rendering the fluid acid with dilute sulphuric acid the blue coloration of the chloroform disappears, and the supernatant fluid becomes pink. The addition of ammonia again renders the chloroform blue.

The odor, too, of the pyocyanine is characteristic.

As an experiment 5 cc. of a fresh broth culture (24 hrs.) from this first case was injected into a vein in the ear of a healthy rabbit. In less than twenty-four hours the animal was unable or unwilling to move, and the hind legs became stiff. A slight diarrhœa set in, all the muscles stiffened, and death occurred forty hours after inoculation. On examination small punctate red hemorrhages were seen in the mucous membrane of the stomach and on the surface of the heart. From the liver, spleen, kidneys, blood, and urine the bacillus pyocyaneus, alone, was obtained.

Case II. C. B. was left by her mother in the nursery on June 7. The infant was small and thin, weighing 7 lbs. 4 oz., and had a purulent discharge from both ears. During the first week there was a gain of four ounces and the discharge from the ears ceased. After that she steadily failed, stools became frequent, green, and very offensive. There was a general lividity of the whole body with several pustules full of yel-

low pus on the head, but no purpuric spots or cutaneous hemorrhages were ever observed, Two days before death there was general rigidity of the muscles. The child died on July 1, three weeks after admission. Autopsy was performed three hours after death. All the abdominal and thoracic organs were pale—the mucous coat of the stomach and intestines thickened, with a few scattered hemorrhages, especially in the small intestine. The bladder was distended with pale urine. Culture tubes of gelatine prepared from the kidney, spleen, and liver presented the growth of the bacillus pyocyaneus alone.

Two weeks later a rabbit was inoculated from one of the cultures, and died in nineteen hours. At the post-mortem, hemorrhages were seen in all the organs, but most marked in the stomach, especially at the cardiac end and kidneys. Cultures taken from the organs presented the green-coloration but much less marked than in those taken from the child.

There were two other cases in which the bacillus under discussion was found in only a single part of the body and in association with other organisms.

Case III. M. B. after a month of good health began to waste and have green diarrhœa and fever. Humorous pustules and subcutaneous abscesses developed all over the body, in a few of which the pus was of a brownish pink, and from them growths on nutrient media were obtained which presented all the characteristics of bacillus pyocyaneus but in association with the staphylococcus pyogenes.

There was no autopsy.

Case IV. M. R., admitted to the nursery twenty hours after birth. Partly wet-nursed. She maintained her weight for three weeks, when a purulent discharge from both ears was noticed, which was checked in four days. The symptoms which then followed were diarrhœa, wasting, general lividity, elevated temperature (100°), and cold extremities. Three days before death numerous small hemorrhagic spots of a port-wine color on the abdomen and back, a large patch over the right scapula, a few on head, shoulders, and legs, a large bedsore over the sacrum. The lower limbs became fixed and rigid, the child crying when they were straightened. Temperature fell to 95°.

At the autopsy two hours after death all the organs were very pale except the spleen, which was large and dark. There were signs of intestinal catarrh, but no hemorrhages. There were no lesions in any other organ. Intestines full of yellow faeces, bladder empty. Cultures from the various organs remained sterile, except the one from the caecum, which, on the following day, showed green color, and from among the intestinal bacteria bacillus pyocyaneus was isolated.

Here, then, we have a series of cases, all of which present very similar symptoms, associated with a definite micro-organism, which, when cultivated and injected into rabbits, produces all the symptoms and pathological lesions observed in the infants.

We therefore draw the following conclusions:

1. That the infant tissues are susceptible to the invasion of the bacillus pyocyaneus.

2. That the bacillus is distinctly pathogenic, setting up a disease similar to the experimental pyocyanic disease.

3. That this disease is characterized by a train of very definite symptoms, namely, diarrhœa, fever, rapid emaciation, rigidity of the legs and hemorrhage, and bullous eruptions.

4. That the disease appears to be very fatal.

As this combination of symptoms occurs not infrequently in young children, especially when congregated in nurseries and foundling asylums, we venture to infer that a certain proportion of the deaths which now appear upon our records of vital statistics under the headings of gastro-enteritis, purpura, or marasmus are in reality cases of generalized pyocyanic disease.

As to prophylaxis we have nothing definite to offer, at present, beyond the strict observance of the laws of hygiene, fresh air, suitable nourishment, and cleanliness. But we are inclined to consider that this disease is one eminently suited for the trial of "serum-therapeutics." It is a disease in which, experimentally, immunity can be easily produced in susceptible animals, and this being so, it is probable that the serum of animals vaccinated against the disease, or substances obtained from such serum will be found, as in the case of diphtheria, to have curative effects.

REPORT OF THE COMMITTEE ON WATER SUPPLIES.[1]

At the last meeting of the Association your committee closed its report with the suggestion of a coöperative investigation into the bacteriology of water supplies as a means of bringing order out of the present chaotic state of the literature of water bacteria, and of throwing light from the bacteriological side on questions of practical sanitation. This was approved by the Association, and your committee was authorized to build itself up into a committee for collective bacteriologic investigation.

At the same meeting there was referred to the chairman of your committee a resolution of the Association that the congress of the United States be memorialized on behalf of the appointment of a commission clothed with power to investigate fully the whole subject of the pollution of rivers and lakes by municipal and manufacturing waste, and provided with sufficient means to enable it to conduct the examination in such manner as shall be deemed best, the results of such examination to be published from time to time for the public information. In connection with this resolution a bill, H. R. 8481, was introduced by Mr. Bartholdt (Missouri) in the third session of the Fifty-third congress, as follows:

That a commission shall be appointed to investigate fully the subject of the pollution of rivers and other natural sources of water supply where the sanitary condition of the people of more than one state is affected or threatened to be affected by such pollution, this commission to consist of three members, to be appointed by the president, by and with the consent of the senate, whose compensation during the time when actually engaged in the performance of their duties under this act shall be ten dollars per diem each, and reasonable expenses.

SEC. 2. The commission shall meet in Washington, D. C., within thirty days after the passage of this act to consider the methods to be adopted in the investigation, and it shall have authority and be empowered to make use of the services of chemical, bacteriological, and sanitary experts and of such persons as it may judge most competent by reason of their special knowledge and experience to afford it correct information on the subject of its inquiry, as well as in formulating its methods and in carrying them into effect. It shall meet thereafter from time to time at such places as it may consider best suited for the furtherance of its inquiry.

SEC. 3. The commission shall report to congress at its next session the progress made in the investigation undertaken under this act, and shall submit suggestions as may seem desirable with the view of remedying any insanitary conditions that have been developed by its work.

In support of this bill the resolution of the Association was communicated by the chairman of your committee in a letter to the speaker of the house of representatives and to the presiding officer of the United States senate. The bill was considered by the house committee on interstate and foreign commerce, but it was speedily apparent that there would be no possibility of bringing it to a successful issue, owing to the shortness of the session. Mr. Bartholdt purposes bringing the matter before

[1]Submitted May 8, 1895.

the next congress with better prospects of carrying it through. Your committee recommends that a renewal of the support of the Association be formulated on behalf of Mr. Bartholdt's efforts.

With a view of carrying into effect the proposed collective investigation, the members interested had several meetings in Montreal, and have since then carried on a steady correspondence. At the first meeting a sub-committee on organization and methods of laboratory procedure was appointed, consisting of your chairman and Professors George W. Fuller, J. George Adami, and Wyatt Johnston. These members, on behalf of the committee, issued letter No. 1, a copy of which is appended, presenting the proposed scheme to the bacteriologists of the country, and inviting their coöperation. This letter, it will be observed, also requested information as to the composition and methods of preparation of the various culture media employed in each laboratory and the system followed in their use in the determination of species. It was hoped that from the replies a scheme of laboratory work might be elaborated, which would receive the approval of all concerned, and be adopted as the standard media and methods of the collective investigation.

Meanwhile the committee was strengthened by the formation of an advisory council consisting of Surgeon General Sternberg and Professors W. H. Welch, T. M. Prudden, V. C. Vaughan, and Theobald Smith. The current work and duties of these gentlemen prevented them from having a personal participation in the investigation, but they kindly responded to the request of the committee for the benefit of their views and experience in effecting an organization and outlining and defining the work to be accomplished.

The sub-committee, after a full consideration of the replies to its letter No. 1, concluded that it would be unwise to make any effort at the differentiation of species by our present methods. It therefore issued letter No. 2, a copy of which is hereto appended, in which it indicated in a general way the errors of the present methods, and concluded that the formulation of a standard method of work would require a full discussion of certain questions at a called meeting. To facilitate discussion and aid the bacteriologists of the several laboratories in gathering the evidence which they have at hand, the sub-committee submitted twelve questions, in the hope that their settlement would enable it to elaborate its scheme of laboratory procedure, and permit the coöperative work on the bacteriology of water to progress on lines leading to the advancement of bacteriologic knowledge and to the practical sanitary results desired by the American Public Health Association.

At the present writing it is expected that the meeting will take place in the Academy of Medicine, New York city, June 21, next.

Respectfully submitted,

Charles Smart, Major and Surgeon, U. S. Army,
Chairman Committee.

AMERICAN PUBLIC HEALTH ASSOCIATION.

COMMITTEE ON WATER SUPPLY.

Letter No. 1. OCTOBER 16, 1894.

SIR,—Owing to the unsatisfactory state of our knowledge in regard to the differentiation and identification of species of bacteria in water, a proposal that coöperative work upon the subject should be undertaken among American bacteriologists was recommended in the report of the committee of the American Public Health Association upon "Pollution of Water Supplies," at the meeting of this Association in Montreal, September 25, 1894. This proposition, emanating from the McGill University, Montreale advises the adoption of uniform standard culture media and the employment of the samd along the lines of a definite systematic scheme, to be determined upon by the associate., workers. It was further proposed that each laboratory, willing to coöperate in this work devote itself particularly to a single so-called group of species of water bacteria. The necessity for some such coöperative plan is generally recognized by experienced bacteriologists, and this recommendation received the cordial and substantial support of the A. P. H. A. in the form of a grant for preliminary expenses.

We, the undersigned, having been appointed a sub-committee and charged with the duties of discovering to what extent the bacteriologists of America are willing to coöperate to this end, what laboratories there are possessing the required facilities for carrying on a work of this nature, and what work has in them been accomplished in the identification and differentiation of species, beg you to inform us whether you or any of those working in your laboratory are willing to coöperate in this work. At the same time (in order that the sub-committee may without delay be enabled to lay the framework of a scheme of combined work before those interested) we shall be thankful to you if you will aid us by answering the following questions at your very earliest convenience:

(1) What evidence has been obtained in your laboratory as to the variability of species?

(2) What culture media have you in most common use?

(3) Will you kindly give us as detailed a description as your time will permit of the composition and methods of preparation of the various culture media employed in your laboratory?

(4) What system do you follow in the employment of the various media for the identification of species?

(5) Can you mention any special points in the preparation and employment of media, which you hold to be of material aid in the identification of species?

Inasmuch as most of these questions admit of being answered at very varying length according to the opinions and experience of different observers, we have thought fit not to print them on spaced forms. We would esteem it a favor if they be answered by number and in such a way that each reply may be tabulated and preserved. And as this may be the first of a series of letters we would suggest that for future reference and correspondence copies be kept of the replies sent by you.

We enclose an extra copy of this letter begging you to give it to anyone whose name is not upon the enclosed list of those to whom the letter is being addressed in the first place, who in your opinion is likely to coöperate in the event of the scheme here indicated being found practicable.

We are, sir, yours faithfully,

C. A. SMART, M. D.,
Surgeon and Major U. S. Army,
Chairman of the Committee upon Pollution of Water Supplies, A. P. H. A.

G. W. FULLER, Sc. B.,
Biologist in charge of the Lawrence Experimental Station, Mass. State Board of Health.

WYATT G. JOHNSTON, M. D.,
Bacteriologist to the Board of Health of the Province of Quebec.

J. GEORGE ADAMI, M. A., M. D.,
Professor of Pathology, McGill University of Montreal.

AMERICAN PUBLIC HEALTH ASSOCIATION.

Committee on Water Supply.

Letter No. 2. April 6, 1895.

Sir,—In the present communication the committee desires to review briefly the present status of the differentiation of species of bacteria, and make such recommendations for future work as appear advisable from our present knowledge of the subject.

Since the epoch-making event in 1881 of the application by Koch of solid culture media to the study of bacteria, great progress has been made in bacteriology and in its application to medical and sanitary science. In this time the discovery has been announced of the specific organisms of many of the most prevalent diseases, and much attention has been devoted to the bacteriology of water, air, and soil.

Considerably before the end of the first decade after this event it became apparent that the original descriptions of the specific characteristics were insufficient to clearly differentiate some of the most important bacteria. Furthermore, as the increased breadth of the bacteriological field brought to light numerous allied species it was learned that, generally speaking, no single laboratory test could be depended upon for diagnosis.

Differentiation of species is now made with comparative certainty after studying a dozen or more characteristics. But in spite of this fact and the aid received from the publication of more than four hundred descriptions of species of bacteria, apparently new species are repeatedly met, and the identification of some of the most important bacteria is still associated with considerable uncertainty. In fact it is the belief of many bacteriologists that with increasing knowledge of bacteria along the present lines of investigation comes increasing difficulty in species differentiation. The time has apparently arrived when we should come to a halt and ask ourselves what is the cause of this state of affairs, and what can be done to remedy it.

In discussing the present status of species differentiation it must not be forgotten that while the higher organisms are identified with comparative ease by their morphological characteristics, in the case of the bacteria these characteristics, with the present microscopical facilities, are insufficient for differentiation. Bacteriologists are compelled, therefore, to depend almost wholly upon physiological characteristics. This is not such a drawback as at first sight might be supposed, inasmuch as under constant conditions fixed results may be looked for; under parallel conditions, parallel results. It is well known that bacteria are very sensitive to their environment, and that they multiply at an enormous rate under favorable conditions by fission. It is for these reasons that, while exact systematic methods and accurately known and carefully recorded conditions are essential to substantial progress in all lines of science, this statement is particularly true for bacteriology.

Under varying conditions so-called varieties of species are readily obtained. Such "varieties" may arise, (1) from differences in environment in nature and (2) from divergent conditions in laboratory methods. The "varieties" of the first class are largely beyond the control of the bacteriologist, but form an interesting and important subject of study. With regard to the second class it may be said that there is every reason to believe that by the employment of more accurate and scientific methods such "varieties" can be lessened to a great extent. It is evident, furthermore, that the first named "varieties" cannot be satisfactorily studied until control has been obtained over the latter class.

The inadequacy and inaccuracies of the present methods of differentiation have recently become more and more apparent. In the opinion of those who have given the matter most attention there appears to be little doubt that the present methods fail to inhibit the production of varieties during the course of laboratory study, and that until life histories in the laboratory can be fairly controlled, and until reasonably normal environment can be obtained, there is little hope of a satisfactory differentiation of species. It is this point which is uppermost in the minds of the committee. Upon the ability of bacteriologists to grapple with the present varying conditions of laboratory procedure depends the future of bacteriological diagnosis.

From the available data it is possible to point out the errors in the present methods only in a general way. The most marked faults are as follows:

(1) The want of a due recognition of the great importance of the reaction of culture media. Lœffler showed in 1890 that the development of the bacillus of diphtheria upon media varied greatly with the reaction; and in the quantitive determination of bacteria in waters variations in the reaction of the culture medium have repeatedly been

found to cause two, five, and in extreme cases more than ten-fold divergencies in the number of bacteria.

(2) The composition of media, exclusive of acid or alkali, is far too variable.

(3) The conditions for development, other than media, are, generally speaking, not sufficiently parallel nor in published accounts are these conditions detailed sufficiently to enable one bacteriologist to feel sure of confirming the work of another.

(4) In studying the results of cultivations the records are not sufficiently systematic or complete.

From the replies to Letter No. 1, the committee prepared a schedule of methods for laboratory procedure; but after long deliberation it concluded that it would be unwise to publish the scheme or to proceed with species differentiation at present, for the reason that methods are still too inexact, and, with the exception of minor details, are not superior to those in the recently published text-books. In reaching this conclusion, the committee has been mindful of the fact that there are two phases of the problem before it: first, the necessary scientific investigations in pure bacteriology; and second, the practical application of the best available methods for the isolation and identification of water bacteria. The wisest course to adopt under the existing circumstances appears to be to re-establish the first principles of the subject and place them upon a more substantial foundation.

With regard to the replies to Letter No. 1, there are three points to which the committee wishes to invite attention,—

(1) That exactitude of laboratory methods is of the utmost importance in the differentiation of species, and in the consideration of "varieties" of species. This fact, it will be noted, has been repeatedly considered in this communication.

(2) In the neutralization of media, titrations should be made with phenolphthalein as an indicator and acidity neutralized with caustic soda. This appears to give greater precision than the use of litmus paper and sodium carbonate.

(3) Wurtz's litmus lactose agar is a valuable medium for some lines of work, especially for the differentiation of B. typhi abdominalis in water.

In order to facilitate subsequent discussion, and to aid the bacteriologists of the several laboratories in gathering together the evidence which they have at hand, the committee begs to submit the following points as among the most important ones which need careful consideration:—

(1) What method shall be followed in neutralizing all media, and what standard degree of reaction shall be adopted?

(2) What effects upon species differentiation are produced by the ordinary differences in composition of peptone meat juice, gelatine, etc.

(3) What media shall be used for all species differentiation, and how shall they be uniformly prepared?

(4) What shall be the medium for, and the condition of, the stock culture from which all media are seeded?

(5) What shall be the systematic, detailed method to be followed in observing the results of cultivations and the manner of recording them?

(6) What method shall be adopted by which full benefit may be derived from morphological characteristics?

(7) What tests shall be used for separating bacteria into clearly marked groups.

(8) What shall be the method followed in determining the relation of bacteria to temperature?

(9) What special methods are of value in the isolation of pathogenic bacteria in water?

(10) What shall be the method of procedure in determining the pathogenesis of bacteria found in water?

(11) What evidence is there at hand with regard to the variability of species?

(12) What new methods can be suggested for the separation of bacteria into groups, and for the identification of species?

There is reason to believe that in several laboratories there are many valuable but unpublished data upon these points. As was suggested in some of the replies to Letter No. 1, the adoption of standard methods and media could be most satisfactorily done after a thorough discussion of all the available evidence. It is accordingly proposed to call a meeting at New York, on June 1, when it is hoped that there will be enough data presented for discussion to warrant the adoption of uniform methods of preparation and use of culture media. At this meeting the committee will bring forward the material which they have accumulated on the several points proposed for discussion. In order to assist in arranging for as complete a presentation of data as possible, it is requested that the committee be informed as soon as practicable whether or not each laboratory will send a representative, what in a general way will be the nature of the material presented for discussion, and whether a later date for the meeting (*e. g.*, June 22) would be acceptable.

In conclusion, the committee desires to express its obligations for the aid received from the replies to Letter No. 1.

Yours faithfully,

CHARLES SMART, M. D.,
Major and Surgeon U. S. Army,
Chairman of the Committee upon Pollution of Water Supplies, A. P. H. A.

G. W. FULLER, Sc. B.,
Biologist in charge of the Lawrence Experiment Station, Mass. State Board of Health.

WYATT G. JOHNSTON, M. D.,
Bacteriologist to the Board of Health of the Province of Quebec.

J. GEORGE ADAMI, M. A., M. D.,
Professor of Pathology, McGill University, Montreal.

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NOTES CONCERNING THE NOURISHMENT OF CHILDREN IN THEIR EARLIEST INFANCY, EXCLUSIVE OF NURSING AT THE BREAST.[1]

BY A. SIMARD, M. D., AND R. FORTIER, M. D., OF THE LAVAL UNIVERSITY OF QUEBEC.

Whether we consult the reports of health officers, or look observingly into public vital statistics, we cannot fail to be impressed with the excessive mortality of children in their first age, especially during summer time.

The percentage of infantile lethality during those few months is so high that we would fain apply to our own country the remarks written in 1878 by Mr. Bergeron, perpetual secretary to the Academy of Medicine of Paris: "No doubt," said he, "the first months and notably the first weeks of life, which conspire to bring about so many causes of diseases and of death, will always, against all odds, furnish a greater proportion of deaths than any other period of life, excepting old age. But is it not distressing to learn that, in our times and in our own country, in spite of the general degree of comfort reached, and the progress of public and private hygiene, the mortality of the new-born should be so great as to justify the assertion supported by figures that a new-born baby offers less chances than a man 90 years old to survive one week, and less chances also than an octogenarian to outlive one year?"

Since that date, however, the situation in France is much improved, thanks to the wonderful impulse given to the study of bacteriology and the constant and intelligently directed efforts of the medical profes-

[1]Presented at the Montreal Meeting of the Association.

sion towards improving the conditions of nutriment during earliest infancy.

Can as much be said of our country? I have my own doubts on the subject, notwithstanding the serious and enlightened efforts of hygienists and health officers amongst us.

I have applied myself particularly to the study of artificial food which is so highly interesting to every practitioner who is desirous of smoothing the way to all beginners in life, and have sought to find the means most likely to remedy the present state of things.

I have given my special attention to the more practical side of the question, and as, within the limited scope of a monograph, it is impossible to embrace the whole subject of artificial feeding during early infancy, I have purposely set aside several considerations of undoubted interest and yet of minor importance in the premises.

Where can we trace the primary cause of infantile mortality during the first year of life?

A glance at the statement of the comparative frequency of the various diseases causing the most disorders of early infancy will at once teach and convince us that out of one hundred deaths among children from 0 to 1 year old, 60 per cent. at least can be ascribed to diseases of the digestive organs.

But what reasons can we invoke to account for the frequency and the lethal character of the diseases of the digestive organs during summer?

Are all children indistinctly subject to contract these mortal diseases? A great distinction is called for in the premises, and we must classify children according to their mode of nutrition.

A baby nursed at the breast by a good nurse, who will not overfeed it, but who will carefully carry out the precept of giving it its meals at regular hours, may, possibly, from time to time, meet with slight digestive complaints, but will very seldom be stricken down with those alarming affections which end so abruptly. Since nursing at the breast is a natural mode of nutrition, there is no reason to suppose *a priori* that much danger underlies its use. And, in fact, sucking, as a mode of feeding, when well conducted, affords the most desirable security. Statistics will, moreover, satisfy the most incredulous. Out of one hundred children sucking the breast, only five per cent. to eight per cent. died during the first year, and the affections of the digestive organs rank low in the statement of relative frequency of the various infantile diseases which caused death.

Professor Rouvier (of Beyrouth) remarked very wisely that we meet with more mothers than qualified nurses. Thus quite a number of mothers lack a sufficient quantity of milk, and are compelled to supply the deficiency by artificial feeding, or they may be possessed of more will than means to carry it out, and in that case they must resort exclusively to artificial nourishment from the outset. Finally, some are to be met with who absolutely refuse to give the breast.

All physicians are aware that in cities a great number of infants are fed artificially, whilst nursing at the breast is daily on the decline, in spite of praiseworthy efforts put forth to oppose that evil tendency. After all, the sucking bottle and the nursery maid are such a boon! And, to speak our mind without bias, is it not, in certain quarters, considered high-toned and in keeping with the age to refrain from what is styled the narrow or mean conception of life, whilst assuredly the contrary, no more praiseworthy and imperious a duty has ever fallen to the lot of the mother of a family?

Apart from these comparatively rare instances, must we not allow for the every day struggle for life that compels mothers of families to seek a livelihood by working out of home?

In short, many infants are partly or entirely fed by artificial process, and this, to my mind, is the primary cause of the frequency of digestive disorders. "To rear children," says Mr. Guèniot, "without the breast, is, in itself, quite an art, for which qualified artists are generally found wanting" (Bull. ac. Med., 1884). As this obligatory or optional mode of nourishment requires constant and enlightened solicitude on the part of those resorting to it, there is nothing to wonder at if it too often misses its aim: First, on account of the difficulty of carrying it out as it should be; and secondly, because of widely diffused prejudices originating in consulting cabinets, and which underestimate its full value, and render it, beyond doubt, excessively dangerous.

My opinion, which is to the effect that wrongly directed artificial feeding, partial or complete, is the main and almost sole cause of the very frequently fatal diseases of the digestive organs, is not shared by the majority. Many physicians, health officers even of repute, may ascribe the whole mischief to the high temperature which prevails during the summer.

They say that a high temperature, whilst heating the superficial layers of the soil, provokes also fermentations which act directly on the infant and affect its health, even to the extent of causing death. This is the seasonal influence so much accredited by the general public who undergo the same with a spirit of resignation which would befit a better cause. All these obsolete notions which obtain somewhat the world over, and which, formerly, for want of better information, used to be repeated more by force of habit than through conviction, should be entirely discarded nowadays, since bacteriology has come to solve the difficulty. Now, that we are better informed on the subject, we say that, whilst the hot season does indeed exert some action on the child, yet that action is merely an indirect one, and, leaving out insolation, it has never proved the immediate cause of a child's death. Its action is easily accounted for. "Milk," says Budin, "is soon impaired by the contact of air. Microbes enter it; the summer heat favors their development, and they swarm in the liquid, which constitutes a ground of culture. Hence, those infectious diseases and *cholera infantum* which occur so frequently,

especially during summer time, through the use of cow's milk, which has to be kept some time before giving it to the new-born. "This accounts for the frequent occurrence of those accidents during summer time and their scarcity during winter." (Lesson at the Charity Hospital, 15th December, 1892.)

A high temperature acts in the very same manner on milk in cans or sucking bottles that are not well filled up, by favoring microbian fermentation and swarming, which daily infect the nursling.

By seasonal influence, as understood at the present day, is meant the filthy, infected sucking-bottle, meaning under unfavorable circumstances or premature alimentation (Comby). Is there anything astonishing in the fact that milk containing *bacilli* of the green cholera, the colon bacillus, that of *cholera infantum*, given to a baby by means of the bottle, which is often in a still worse condition, should be noxious?

Out of 31 sucking-bottles picked up in 10 different nurseries and examined by him, Fauvel found 28 of them swarming with very virulent microbes. A baby resisting such a daily infection can boast of being endowed with great vital powers indeed. No wonder then if the contrary generally occurs.

If I can venture an opinion, I must say that I am thoroughly convinced that the predominating cause of infantile mortality or of the malignity of estival diseases arising from digestive complaints can be traced to artificial nourishment not properly understood, and worse still, badly directed.

It is impossible nowadays to entertain the opinion held forth that a high temperature is the direct cause of choleriform accidents, nor is it less unreasonable to admit that of Virchow, which, however, has met with such strong opposition, regarding the influence of the lowering of the subterranean body of water on the intensity of the digestive disorders in a given locality.

The board of health of New York city has stated that the estival diarrhœa of children is met with especially in wards built on muddy soil called "swamps," but we must merely infer from this statement that these wards are productive of more germs than elsewhere, and that consequently both the milk and the bottle are more exposed to contamination. And, besides, if heat exerts a direct action, why does it not exert the same on children nursed at the breast? We all know how seldom the latter are troubled with diarrhœa. Why should they enjoy this security from heat, from an overheated soil, or from the displacement of the subterranean body of water? The simple reason is that they feed a milk free from various microbes. As a further illustration of this fact take, for instance, England, where the temperature is about the same in every town in summer time, and yet most remarkable differences occur in the prevalence of diarrhœa and cholera. Thus, Leicester furnishes twenty-five per cent. more deaths from those diseases than Merthyr Tydvil.

In Germany, in towns situated in the lower prairies of the Rhine, where the temperature is much higher than in towns situated in the prairies

of the "Saxonian Marches," the number of deaths resulting from diarrhœa among infants is much less; and, finally, in Italy, at Turin and Rome, intestinal catarrh causes much less mortality than in Germany.

During my stay in Paris, it was my good fortune to attend M. Budin's clinics at La Charité, and I was pleased to find that during a fortnight of depressing weather not a single baby, undergoing artificial feeding, was taken ill with diarrhœa. There is nothing surprising in this, after all, but it goes to prove the intelligent direction given to and the harmlessness of artificial nutriment, as well as the inoffensive action of a high temperature.

Now let us take another view of the question, and for that purpose let us consult statistics. At the Quebec hospital, called the "Sacred Heart," which shelters foundlings, artificial nursing is necessarily resorted to with watered milk, the spoon, and the bottle.

And yet, in spite of the good will and the really praiseworthy devotedness displayed by the reverend ladies in charge, under the supervision of physicians, mortality varies between eighty per cent. and ninety per cent., and is almost solely caused by atiepsia and infectious diarrhœa.

According to Uffelman, more than fifty per cent. of children nursed artificially die within the first year at Berlin, and the percentage is reckoned higher when pap and flour is used during the three first months. In Bertillon's reports it is shown that in France, wherever sterilizing was neglected, the figure of mortality was enormous; at Reims, fifty per cent.; in a locality near Lille, eighty per cent.; in Seine and Oise, twenty-eight per cent.; at Calais thirty-nine per cent. etc. In town practice, it is found that infantile mortality due to affections of the digestive organs oscillates during summer time between sixty per cent. and seventy per cent., and the greatest number of these cases of death claim artificial food as their immediate cause.

Now, since the violent digestive complaints of babies can be brought home to artificial feeding, have we not any means at our disposal to remedy this state of things? This is what I will attempt to establish.

In our country it is cow's milk we use almost exclusively. As I intend to limit myself to the practical side of the question, I will purposely leave out the otherwise interesting question of goat's and she-ass's milk in its connection with the nursing of the new-born.

The first condition required for the efficiency of artificial nursing is that the cow's milk be of good quality.

In theory this point is made clear enough by analyses, but practically it is reduced to a question of trust in the honesty of the milkman. Apart from the watering of milk, which some retailers consider a paltry failing, we must also take the diseases of cows into account.

Without going into full particulars, let us simply quote Brown's reports laid before the last International Congress of Hygiene held in London: "A farmer owned a cow whose udder gave only pus. He was taken by surprise when compelled to cease milking her, the more so as he con-

sidered the yellow color as a proof of the richness of the milk, which, when mixed with other milk, should, as he thought, improve the total quantity." (Brown, Congress of Hygiene, L. 1891.)

Besides some microbes reputed harmless, but which produce the fermentation of milk, there are others of a pathogenic character, and whose presence cannot be revealed. These are especially dangerous.

Tuberculosis of the bovine species (curdled), though of rare occurrence, is met with sometimes, and is all the more dangerous, as no symptoms accompany its presence. In support of this, we need only mention a certain cow alluded to by Nocard at the Academy of Paris, which, in spite of its magnificent appearance and prizes awarded it at every exhibition, was, nevertheless, affected with tuberculosis.

This is about the only disease of the bovine race the transfer of which to man, through the agency of milk, has been scientifically demonstrated.

Creighton, of the University of Cambridge, mentions twelve cases of tuberculosis due to the use of milk. (Rouvier, on Milk, p. 154.)

Hutinel and Grancher, in the Encyclopedia Dictionary, sum up the case of a boy four years old, and conclude this wise: "Is it not reasonable to assert without any risk that that child contracted tuberculosis by ingesting milk loaded with bacilli?" (Sigismund, of Bâle.) Demme and Lydtin (of Brussels, 1893) mention conclusive facts based on experiments, and supported by demonstration.

Toussaint, Chauveau, Bang, Nocart, have demonstrated:

First, the identity of bovine and human tuberculosis. Second, the experimental transmission of tuberculosis to guinea-pigs by injecting into the peritoneum the juice of meat or milk coming from tuberculous cows. Third, the experimental transmission (quite possible but not frequent) of tuberculosis to pigs and guinea-pigs, through the ingestion of meat and milk proceeding from tuberculous cows.

As to diphtheria, scarlatina, and typhoid fever (Observations from Geneva), it seems more probable to-day that milk is contagious after milking into cans washed in filthy water or otherwise.

One fact only needs to be borne in mind, and that is, that milk, as it is delivered for consumption, is sometimes noxious, and may introduce into the economy of the person using it the germs of different grave diseases, making its use dangerous. (Thesis, Chavane, Paris, 1891.)

There exists a certain prejudice to the effect that, to secure for a baby as regular a nutriment as possible, it is wise to use, daily, milk supplied by the same cow. The object aimed at is to always assure the child the same food, and the contrary is the result. Gauntrelet (Archives of Tocology, 1893) has demonstrated the great variations undergone daily in the composition of milk from the same cow, whilst the mixing of milk obtained from a whole stable, or from a whole farm, varies little, if at all; and he has further shown that the principle of confining one's self to milk from the same cow, which may be tuberculous, might be attended by more chances of infection for the nursling, the bacillus of Koch occurring

in much greater quantity in one tuberculous cow's milk than in the mixed milk of several cows. The nutritive value of milk also varies according to the breed. Gauntrelet's conscientious analyses prove that, according to breeds, the proportion of nutritive principles per quart of milk varies from 152.3 grms. to 119.24 grms. of dry extract, the Jersey breed heading and the Norman breed footing the list. But as the nutritive substances rarely descend below 105.90 grms. of dry extract, it follows that there is no reason to attach too much importance to such relative richness and poverty in the various breeds, since many circumstances may cause this relative advantage to deviate. The conclusion to be drawn is that it matters much to know whence the milk employed proceeds, as some breeds furnish, per quart, a greater percentage of nutritive substances than others.

Should we give a child pure and raw milk, or is it necessary to submit it to certain processes before using it?

The means suggested most generally to render milk digestible is to water it. As cow's milk contains more dry residue and consequently more assimilating material than woman's milk (which must necessarily be taken as the standard) it is undoubtedly more indigestible if we do not make it undergo certain processes. The curd formed in the stomach is dense and is less easily penetrated by the digestive juice. And in order to remedy this state of things, and the over-supply of casein, acknowledged years ago, and very truly so, to exist in raw and boiled milk, watering has been resorted to. Woman's milk, according to Gauthier, contains 123.5 grammes of dry residue per quart, whilst cow's milk contains of the same 132 to 138 grammes, thus constituting a notably higher proportion. Some time since, Rau exacted two parts of water for one of milk, whilst Biedert, evaluating at one per cent. the quantity of casein of cow's milk to be left in the food, submitted that three to four parts of water should be added to one of milk, so as to render the latter digestible. Uffelman in his treatise on the hygiene of infancy is quite opposed to such a dilution, which he qualifies as *excessive* and *inadmissible*, because, as he says, it would reduce the proportion of protein far below that contained in woman's milk.

When cow's milk, which contains 4.4 per cent. of protein, is mixed with thrice its volume of water, it gives no more than 1.1 per cent. of protein. The child who takes of this food at least twice as much as the required quantity of woman's milk, absorbs only as much albumen as it needs daily. Moreover, this dilution diminishes in a marked degree some of the mineral ingredients, potassium, for instance.

It has been said that a baby cannot digest more than one per cent. of casein found in cow's milk, and this is the groundwork of the whole theory of watering. This assertion is certainly not proved either scientifically or even clinically. I share the opinion of Uffelman, Saint Yves Ménard, Budin, and others, and say that it is out of the question, and dangerous even, to dilute cow's milk with three parts of water, and I am pos-

itive that the insufficiency of ozotized, fatty matter, and salts must be injurious to the new-born. With such a diet the scales will record a very slight daily increase in the infant's weight, if not unluckily a decrease.

Saint Yves Ménard, in his report submitted to the Medical and Surgical Society of Paris (1892) advises one part of water to three of milk during the first month of life, and one to four from the second to the fifth month, adding sugar (1 to 1.50 grammes per meal of 80 grammes).

Notwithstanding his able defence of *discreet* watering, I cannot endorse Mr. Ménard's views; besides, he soon betrays his wavering belief in watering when he adds further on,—"I am not over-confident in the worth of natural food modified to such a degree. The water mixed, be it ever so perfect, cannot be compared with the water found in the milk compound, and the sugar, were it lactose even, could not in my estimation replace that which forms a constituent part of an organic liquid newly secreted."

Let milk be watered to any degree imaginable, the properties of casein will never be altered, and this, I hold, is a very strong argument against watering, which is intended to render the caseine of milk more digestible by modifying it.

"It would be illusory," says Galanine (thesis by Nicolle, Paris, 1891), "to believe that by watering cow's milk we make it equal to woman's milk. By so doing we neither change the chemical properties of caseine, nor the mutual proportions of all the components."

Perron (France Medicale, 1893) asserts as much. "All watering should be looked upon with suspicion, and should be done with circumspection." Besides, might not the water used be offensive? Yes, certainly, if no pains have been taken to sterilize it, and afterwards if the necessary precautions have been neglected to prevent infection by germs before using it. Indeed, that question of watering cow's milk is not yet definitely judged, and this accounts for my discussing it here. For my part, my opinion is formed, and I declare without bias that I repel watering as inefficacious and dangerous, and loudly proclaim the advantages and the undeniable medicinal qualities of pure but *sterilized milk*. First, because, when sterilized, it never provokes those serious diarrhœas which cause infantile mortality, and next, because, besides that innocuity against dangers inherent to all artificial food, it is well digested by the sucklings.

What is the result when milk is watered in the ordinary way? Let us resort to a comparison. Woman's milk, according to Gauthier, contains, per quart, about 870 parts of water and 123 grammes of dry residue (albuminoid matter, caseine, butter, sugar, salts); cow's milk, on the other hand, contains 865 parts of water and 135 grammes of residue. Well, now mix that quart of cow's milk in the proportion of three to one, or even two to one; you will have 865 grammes of water plus 2,000 grammes of water = 2,865 grammes. Now, since an infant

should not be given during the first months more than 500 grammes of liquid daily on account of the diminutive capacity of its stomach, it will take only the $\frac{1}{6}$ of that mixture, or $\frac{2865}{6} = 477.5$ grammes of water; then in this mixture made up with a quart of cow's milk which you have also watered with two parts, you have been spreading the 135 grammes of nutritive substance over six parts $= \frac{135}{6} = 22.5$ grammes.

The babe who should only take 500 grammes of the mixture in one day really only absorbs 22.5 grammes of nourishing material per day. This is very little, indeed, since 500 grammes of the mother's milk would have given the babe daily $\frac{123}{2} = 61.5$ of the same.

Then, where is the advantage of watering recommended by the majority of authors? Watering would only have produced a dilution of the daily ration of milk, and have given, under a determinate volume, an aliment most wanting in nutritious substance. With such a diet forced on so many infants, the new-born, in order to absorb the equivalent of the quantity he would enjoy by feeding at the breast, would have to take nearly from 1,200 to 1,500 grammes of liquid daily. For it is obvious that since watering diminishes the nutritive standard of milk to such a degree, the infant, in order to increase in weight, would have to absorb a great quantity of that liquid daily. Even a babe cannot be forced to ingest a quantity of food disproportionate with the feeble dimensions of its stomach without suffering for it; an over-distension of the stomach follows, with its lamentable consequences.

We must, no doubt, admit with d'Arthus (Chavane's thesis, 1893) that the density of the curd formed in the stomach of the new-born by casein would be somewhat diminished, but this can never compensate the accidents provoked by such a diet.

"Of course," says Mr. Budin (clinical lesson) "a babe digests cow's milk less easily, and this accounts for the watering of it, but at the same time is it not due to its absorbing a very small proportion of nutritious substance that it increases so little in weight?" This is almost proved by the fact that the child's weight improves very much from the fifth month, that is to say, from the moment it is given pure or nearly pure milk.

The great argument with physicians who, to this day, defend watering, is that pure milk is too indigestible for the very delicate stomach of infants. Well, now, pure milk sterilized is not only more digestible than pure milk non-prepared, and boiled and watered milk, but it is even very easily digested.

"Can we fail to be impressed with the great digestibility of pure but sterilized milk when we find it supported so easily by children born weak and before their time (premature infants)?" Budin, Clinics, Charity, 1892.

Mr. Chavane, in the course of his thesis on sterilized milk, mentions seven premature children weighing 2200 grammes and less at their birth, who were fed from the outset on sterilized pure milk, and whose digestion was good, their general appearance satisfactory, and their increase

in weight what it should be. "Since 1893," adds Mr. Chavane, "these facts have repeated themselves, and I am of opinion that sterilized milk can be given pure to the premature born, without the addition of water." Mr. Budin mentions some like cases in his own practice.

"If this milk agrees so well with children whose stomach is so far from being developed, should not children born at their time digest it better still?"

Comby (Tocol. Archiv., 1893) says, "Pure milk sterilized is a first choice aliment, perfectly *well digested* by healthy and sick children, and perfectly aseptic. I have, at the close of this summer (1890), treated fifty-six infants, from one month to two years of age, and these infants, who were taken ill with seasonal alimentary diarrhœa (sucking bottle, weaning, premature alimentation), were nearly all cured by the exclusive use of sterilized milk. If sterilized milk pure, will cure diarrhœa, it should also prevent it. It is more easily assimilated than milk in its crude state. The excellent results obtained by Drs. Serestre, Olliver, and Debore, by feeding babies on sterilized milk in their hospital have induced them to corroborate this judgment. In his thesis, founded on facts related in Mr. Budin's service at the Charity of Paris, Mr. Chavane gives results which go to prove the wonderful efficacy of sterilized milk, given pure, either to relieve the mother or as an exclusive aliment. Here are the results alluded to: Out of 113 children fed at the breast, there were seven cases of slight diarrhœa, without any consequence; out of 200 children fed at the breast, and with sterilized pure milk simultaneously, there occurred 10 cases of diarrhœa, one only of which was serious enough to create any anxiety; 16 cases of exclusive artificial nourishment met with no accident worth mentioning. These statistics are eloquent indeed. Here are 216 children who ingest pure milk, with casein which, according to many physicians, ought to determine such great disorders in a stomach so little accustomed to the density of its clot, and yet who digest it most easily, and increase in weight on a daily average of 20 grammes, as far as those who are fed on a mixed food are concerned, and 14 grammes as regards those who daily ingest pure milk. Is this not enough to convince the most incredulous?"

It may be objected that these children were not observed more than a fortnight at the hospital and that later on things may have taken another turn altogether.

But the greater number of these children were seen afterwards at the external hospital consultation, and "the facts I have gathered," says Mr. Chavane, "either at Mr. Budin's clinics or at the external hospital consultation are most encouraging and banish all anxiety."

Since these facts have come to notice, I have made use of sterilized milk with no mixture, in my own practice, and have always, so far, averted all intestinal disorders, stamped with any degree of gravity. I can mention over fifteen cases, which served to convince me that sterilized pure milk is well digested, and produces innocuity from bowel com-

plaints, because sterilization destroys all nocuous microbes, excepting of course spores, the consideration of which may, for the moment, be set aside.

Infants, however, who are fed on sterilized milk increase less than those who suck the mother's breast. Saint Yves Mènard (*Journal of Medicine*, Paris, 1892) questions very much whether this phenomenon must not be ascribed to the fact that sterilization destroys certain ferments useful to digestion, or deprives the milk of its dissolved gases. This question is still *sub judice*. What is beyond doubt, however, is that sterilization, obtained by the water bath (*bain marie*), approaching a temperature of 100° centigrade, seems to operate certain modifications in milk which facilitates its digestion; in the stomach casein forms small clots instead of taking in a lump, and this would seem to account for the digestibility of sterilized milk (Budin). This is, besides, the explanation given by Mr. Chavane. But, whatsoever the explanation, it is an established fact that sterilized milk given pure is well digested by babes, and is consequently capital food in so far as artificial nursing is concerned. It is well understood that I deal here only with the question of food, and not with that of digestive complaints, which is altogether a different topic, and which suggests many other considerations.

The object of hygiene is especially to avert diseases, and it is through well digested food that we can protect early infancy against those diseases of the digestive organs, attended with such a gloomy prognostic.

I therefore advise pure milk; but to remove all danger it must previously undergo a process of preparation, which will stamp it with a character of perfect innocuity. Apart from special diseases transmissible through milk (tuberculosis, typhoid fever, scarlatina(?), diphtheria), there are, above others, certain bacilli, which when sufficiently virulent and numerous, determine by their ingestion diarrhœa and intestinal disorders, which too often prove fatal. Such are the accidents to be most guarded against. I will systematically set aside *pasteurization*, and sterilization by industrial processes which, at present, are scarcely practical in our country; as well as prepared milk which most of our families will find too costly. It is the children's vital interest that the milk just sterilized be used within the twenty-four hours; many accidents will be avoided if this advice be followed, and therefore it is advisable, and necessary even, that families should do their own sterilizing (Budin).

There are two important points to be observed in sterilization: 1. The process itself; 2. The preserving of that sterilization. And we must also distinguish between the laboratory sterilization which requires the milk to be heated above 110° centigrade, and practical sterilization which affords more than sufficient innocuity.

The process I would recommend for sterilizing is that by the water bath *(bain marie)*. The milk after heating during one-half to three-quarters of an hour reaches 100° centigrade. It does not boil at that temperature, for it has been shown by many experiments that its point of ebullition is 101°.5; this distinguishes sterilized from boiled milk, which

is hard to digest and has a different taste. There is nothing astonishing in this, when we recall Lesage's experiments, which go to show that milk boiled in the open air during five minutes is reduced a quarter of its volume. And then it often brings on digestive complaints (colics), frequent constipations at times, diarrhœa (A. Laurent).

"It is quite evident," says Duclaux, "that boiled milk cannot be assimilated to milk that has not undergone ebullition. It is less digestible, and tastes differently."

Both these inconveniences are avoided by sterilizing milk in the water bath. The molecular transformation of its casein is not revealed by a special taste, whilst on the other hand its digestibility is increased instead of being diminished.

At a temperature approaching 100° centigrade the noxious microbes are all killed, and consequently all fears removed in that respect.

The best sterilizing process is that of Gentile, which is merely a modification of that of Soxhlet, of Munich. It simply consists in a closed boiler, half replenished with water, wherein a certain number of bottles, resting on a stand, are placed, each bottle containing the quantity of milk necessary for one suck. These bottles are filled three-quarters with milk and covered with a rubber stopper, shaped nail-like, the stalk plunging into the bottle. As we have said before, these bottles are placed on the stand in the boiler (*bain marie*) water bath, in which the water level must rise above the milk level. The water is raised to ebullition during three-quarters of an hour. The expanded air escapes from the bottles by raising the stoppers (nail-like) which, on withdrawing the bottle, rest on the nozzle of the bottle by their own weight. By consideration of the vapor in the bottles, the atmospheric pressure steadies and depresses that elastic covering, and the stopper happens to close the bottle hermetically, and remains solid. The more vacuum obtained, the more severe the corking. We must be sure that the milk is perfectly sterilized before using it. When about giving the child one of these bottles, which represent the day's ration, we draw out the stopper and apply to the nozzle of the bottle a rubber teat which must have steeped in boiled water, after having been carefully washed in hot water.

What remains in the bottle just sucked should not be used subsequently, but must be thrown away. This is why the bottle should not be filled up with more than the equivalent of one suck.

Gentile's apparatus is the most perfect known so far, but as it is still rather costly for some families, I will suggest a very simple device in its stead.

Place in an ordinary boiler, filled one third with water, the daily provision of milk contained in any kind of bottles (apothecaries', for instance) two thirds full. Each bottle must contain 80 to 100 grammes of milk; then heat to ebullition, and maintain it so for three quarters of an hour; after this lapse of time withdraw the water bath (boiler) from the fire, and stop each bottle with a cork cleaned in boiling water or one made of

wadding (hydrophile cotton, borated). Thus the day's ration is prepared. You have then only to replace the cork by a rubber teat, and the child is "treated" to pure sterilized milk, from a bottle which is a favorable substitute for all sucking bottles, having over the latter the advantage of being free from all noxious germs.

This plan does not, of course, offer the same immunity as that afforded by the Gentile apparatus, but its simplicity, its cheapness, the possibility of vulgarizing it, and the splendid results obtained from its use when properly watched, recommend it, particularly to those social classes to whom the cost of the most simple apparatus is still burdensome.

In conclusion, we should bear in mind that, to avert infectious and fatal diarrhœas, we should never give the nursling an aliment which is liable to introduce noxious germs into its stomach. By sterilization all these dangers are prevented.

As an infant must not only live, but must grow also, it is better to give it pure milk, because, given in a quantity which will not over-distend the stomach, it is well digested, provokes no vomiting, and, after all, fairly replaces nursing at the breast, when the latter is impossible. Thanks to such a diet, the infant will grow, and will be well guarded against all danger.

Now with sterilization, choleriform diarrhœas and infantile cholera, which are so frequent during the summer heat, must almost entirely disappear, as it is not rational that they should exist the moment an infant is made to absorb food containing no microbes; and daily experience tends to prove this more and more.

Artificial food, were it still more perfected even, can never be fully likened to the mother's breast, but, whenever the latter is insufficient or null, artificial nursing on sterilized milk will resume its rights, and will do so for the greatest benefit of the suckling of any age or of any condition.

ADDITIONAL REPORT OF THE COMMITTEE ON POLLUTION OF WATER SUPPLIES.

SUBMITTED JULY 15, 1895.

A preliminary report from your committee, dated May 8, 1895, and published in the July issue of the *Journal*, explained the progress made by the committee and the difficulties encountered up to that time. Briefly, a sub-committee, consisting of the chairman of the committee, Mr. George W. Fuller, Dr. Wyatt Johnston, and Professor J. George Adami, appointed to determine the organization and methods of laboratory procedure to be adopted by the committee, found it impossible to elaborate a satisfactory scheme of work until certain questions, mostly relating to technique, had been discussed fully and settled in accordance with the most advanced knowledge of the various subjects. To accomplish this the sub-committee called a convention of bacteriologists to be held in New York city, June 21 and 22, 1895. Most of the prominent bacteriologists of the country were present, and full discussion was given to the questions at issue under the chairmanship of Professor William H. Welch of Johns Hopkins University. No decision was reached on any of the questions, but the whole series was referred to a committee of nine members with the understanding that the convention would accept its decision, and that its members would modify their laboratory methods in accordance therewith, the report of the said committee to be rendered to the water committee of this Association.

Your committee therefore now awaits the decision of the convention as given by its committee, and in the meantime transmits copies of the papers read at the convention, and the stenographic report of its proceedings.

Respectfully,

CHARLES SMART, Major and Surgeon U. S. Army,
Chairman.

PAPERS AND PROCEEDINGS OF THE CONVENTION OF BACTERIOLOGISTS.

HELD AT

NEW YORK CITY, JUNE 21–22, 1895, UNDER THE AUSPICES OF THE COMMITTEE ON THE POLLUTION OF WATER SUPPLIES, OF THE AMERICAN PUBLIC HEALTH ASSOCIATION.

ON THE PROPER REACTION OF NUTRIENT MEDIA FOR BACTERIAL CULTIVATION.[1]

BY GEORGE W. FULLER, S. B.

BIOLOGIST IN CHARGE OF THE LAWRENCE EXPERIMENT STATION, STATE BOARD OF HEALTH OF MASSACHUSETTS.

I. HISTORICAL RESUMÉ.

In the original description of the adaptation of solid media to bacterial cultivation, in 1881, Koch (1) stated that the nutrient gelatine should be neutralized with potassium carbonate, sodium carbonate, or basic sodium phosphate. The directions in the leading text books of to-day, some fourteen years later, can scarcely be said to be more specific. Some say, Render the medium slightly alkaline; others say, Neutralize; in some books, blue litmus paper is recommended as an indicator, while in others the indicator recommended is red litmus or turmeric paper, and in many cases, indeed, no reference is made to the indicator. As for the neutralizing solution the recommendations still include the carbonates and phosphates as well as the hydroxides, and preference is given in some instances to a mixture of all three. All things taken into consideration, it may be fairly concluded, with regard to the reaction of culture media, that since the dawn of modern bacteriology there has been taken no step in advance, which has met with general recognition and acceptance.

This fact is more remarkable because bacteriological literature abounds with statements showing the great importance of this point. It is true that practically none of the articles of reference bear a title corresponding to the above, and that little clue to the matter is obtained from indices to the literature. But, from a careful study of the principal journals, more than one hundred references have been found throwing light upon the question at hand.

[1] By permission from a forthcoming report of the State Board of Health of Massachusetts.

Most of these references are scattered through prominent articles upon the etiology of the principal infectious diseases and the biology of their specific germs; upon disinfection, immunity, bacteriology of water and the preparation of culture media. A considerable portion of the literature is of value in this connection only along the line of general confirmation, and on the present occasion it is proposed to deal only with the most important articles, and in such a way as to bring out, historically, the influence of reaction of media upon the cultivation of bacteria.

1. *Pigmentation.*—In 1884, Hueppe (2) found that the formation of a blue pigment by *B. cyanognus* (blue milk bacillus) depended largely upon the reaction of the medium. This observation was confirmed by other investigators, and Wasserzug (3) showed that the reaction of the media greatly influenced the pigmentation of *B. pyocyaneous*, *B. prodigiosus* and *B. janthinus*. To this list Laurent (4) added *B. ruber* and *M. indicus*, and Clæssen (5) a blue pigment forming bacillus from water. All chromogenic bacteria do not seem to be similarly influenced, as Lustig (6) found that the reaction of the media made practically no difference with the pigmentation of a red bacillus from river water.

2. *Sensitiveness of Pathogenic Bacteria to Reaction of Media.*—In 1885 Buchner (7) made some interesting experiments, the results of which indicated that varying relations existed between the reaction of media and the development of Emmerich's bacillus, Eberth's bacillus of typhoid fever, Koch's cholera spirillum, and a fæcal bacillus. Numerous investigations of a similar nature have been made since that time upon many of the best known species of bacteria. Owing to the lack of uniform and accurate methods, it is difficult to compare many of these results with one another. As a matter of convenience some of the more important are recorded, without further comment, in the following table:

Number.	*Name of Bacteria.*	*Investigator.*
1.	B. *anthracis.*	Sirotinin (8).
2.	*Sp. cholera Asiatica.*	Kitasato (9), Heim (10), Dahmen (11), Stutzer and Burri (12), Koch (13), Fluegge (14), Hesse (15), Kruse (16).
3.	B. of green diarrhœa.	Lesage (17).
4.	*B. diphtheriæ*	Zarniko (18), Lœffler (19), Boer (20), Deyeke (21).
5.	*Sp. Finklor-Prior.*	Sirotinin (8).
6.	B. of swine plague.	Frosch (22).
7.	*Dip. lanceolatus.*	Bordoni-Uffreduzzi (23).
8.	B. of malignant œdema.	Novy (24).
	B. of Milzbrand.	Smirnow (25), Behring (26), von Lingelsheim (27), Czaplewski (28).
10	*Dip. pneumoniæ.*	A. Fraenkel (29), Kruse and Pansini (30).
11.	B. of Rauschbrand,	Kitasato (31).
12.	B. of Rotzbrand.	Boer (32).
13.	*B. salivarius septicus*	Biondi (33).
14.	Septicæmia cocci.	A. Fraenkel (34).
15.	Streptococci.	von Lingelsheim (35), Knorr (36).
16.	*B. tetanus.*	Kitasato (37).
17.	*M. tetragenus.*	Sirotinin (8).
18.	*B. typhi abdominalis.*	Esenberg (38), Schiller (39), Holz (40), Belfanti (41), Petruschky (42), Fuller (43), Koehler (44), Mathews (45), Sommaruga (46).

3. *Phosphorescence.*—In 1887, Fischer (47) found that the power of *Bacterium phosphorescens* to produce this characteristic was fully as great in acid as in alkaline media. Lehmann (48), however, working with an old culture of this germ, stated that optimum development appeared in media neutral to litmus.

4. *Morphology.*—In 1888, Wasserzug (49) stated that the morphology of *B. prodigiosus* was influenced to a marked degree by the reaction of the medium in which the germ was cultivated. Results of a similar nature were obtained by Buchner (50), Neisser (51), Schiller (39), and Claessen (5) when working with other bacteria, including those of disease.

5. *Determination of Degree of Reaction by Titration Methods.*—In 1888, Behring (52) introduced titration methods, with rosolic acid as an indicator, for the more accurate determination of the degree of reaction of blood serum of different animals. This indicator has been used to some extent in connection with other culture media. Schultz (53), in 1891, recommended the use of phenolphtalein. A full discussion of the determination of the degree of reaction is given beyond.

6. *Reaction of Blood and Immunity.*—In the same article in which Behring (52) described his titration method, he advanced the idea that the immunity of white rats against milzbrand was due to the high alkalinity of the blood. Very instructive results along this line of study have also been obtained from the investigations of Fodor (54), Buchner (55), and Emmerich, Tsuboi, and Steinmetz (56).

7. *Reaction of Media and the Quantitative Determination of Bacteria in Water.*—In 1891, Reinsch (57) showed that varying numbers of bacteria in water were found when to the ordinary slightly alkaline gelatine different amounts of sodium carbonate were added.

During the same year the marked influence of reaction of media in bacterial water analysis was learned independently by the writer (58), and described in the Twenty-Third Annual Report of the State Board of Health of Massachusetts for the year 1891. Since that time, contributions to our knowledge upon the subject have been made by Dahmen (59), Burri (60), Chomski (61), Reinsch (62), Kleiber (63), Grahn (64), and the writer (65).

II. DISCUSSION OF THE APPLICATION OF THE RESULTS OF RECENT PROGRESS IN ACIDIMETRY AND ALKALIMETRY TO METHODS FOR THE PREPARATION OF CULTURE MEDIA.

The method by which the reaction of media shall be determined is a matter of much importance. At the beginning of the discussion it will be well to review briefly the advance which has been made in our knowledge of acidimetry and alkalimetry during the past fifteen years.

As in former years we are still unable to define an acid accurately, but must consider the terms acid and alkaline as relative ones. Our

knowledge of the relation of these two terms, however, has been largely advanced through the series of admirable investigations by Robert T. Thompson (66), upon the use of indicators derived from the aromatic compounds. The use of certain of these indicators for certain determinations, and the employment of several of the indicators for the same problem, have led to much greater precision with regard to the reaction of solutions. Information concerning these indicators is still imperfect; yet, as Sutton (67) states, their use is an immense advance upon the old-fashioned litmus.

In order to point out clearly the fact that the term reaction should be regarded in a relative but not in an absolute sense, it may be mentioned that under ordinary circumstances saliva is neutral to litmus, acid to phenolphtalein, and alkaline to methyl orange. Fresh milk usually behaves in the same way, although no sharply marked line can be drawn. Such solutions as these are said to have an amphoteric reaction, which means that they possess both acid and alkaline properties, according to the indicator used. To this class of bodies having an amphoteric reaction, belong the ordinary nutrient media as they are prepared for bacterial cultivations. The most accurate method for the determination of the reaction of nutrient media has been found to be by titration, with the use of phenolphtalein as an indicator. This indicator was first recommended for this purpose in 1891 by Schultz (53), who found its use to be very satisfactory, and who also stated correctly, that the results obtained by litmus were not sufficiently accurate. Universal adoption of phenolphtalein appears to have been largely retarded by the statement in 1892 by Dahmen (11). He claimed that its use was not feasible, owing to complications from carbonates and ammonium salts present in the media. Difficulties in this direction may be readily obviated by proper technique as I shall show beyond.

In 1893, Petri and Massen (68), in their description of the preparation of nutrient bouillon employed in the laboratory of the Imperial Board of Health at Berlin, stated that the amphoteric reaction was due to the presence of phosphates, and advised the use of phenolphtalein in conjunction with lackmoid as indicators. For the reaction of nutrient gelatine and agar, prepared from phenolphtalein bouillon, they used litmus.

At the close of that year, 1893, Timpe (69), in a description of the methods of preparation of nutrient media used in the laboratory of Professor Wolffhüggel (70) at Göttingen, confirmed the earlier statement that phenolphtalein should be used as an indicator, owing to the difference in reaction of mono- and di-basic phosphates. He also pointed out that there are present in peptone and in gelatine, albuminous bodies, which possess both an acid and a basic nature, but in which the acid character predominates. To determine accurately the reaction of such amphoteric compounds, from the bacteriologist's view, Timpe (69) stated that it is necessary to use phenolphtalein as an indicator. Turmeric paper, however, seems to serve this purpose nearly as well

as phenolphtalein. It may be further stated that somewhat similar organic compounds of an acid nature exist in meat infusions, as is shown by the fact that in the ash from ignited blood serum there are insufficient mineral acids to unite with all of the bases, plainly indicating that part of the bases were combined with organic substances.

Before describing the technique by which the reaction of the various ingredients of culture media can be determined best, a few words concerning the general nature of the several indicators will be appropriate. Allen (71) states that the sensitiveness of an indicator for the determination of the reaction of any solution depends upon the relative strength of the acid which enters into the composition of the indicator compared with that of the acid in the solution under examination; and, furthermore, the former acid must be weaker than the latter in order that the acidity of the solution in question may be correctly determined. The acid of phenolphtalein is weaker than the acid of the other indicators; hence the superior value of this indicator for determining the reaction of solutions containing the weak acids of meat infusions, peptones, etc. On the other hand, the acids of methyl orange and lackmoid are comparatively strong, and, as is well known, these indicators are the best for determining alkalies, since the weak acids, including most of those of an organic nature, are not strong enough to decompose their acids. Somewhere between phenolphtalein and methyl orange or lackmoid, in point of sensitiveness to acids and alkalies, stand litmus and rosolic acid.

Since phosphates are present in culture media it is of interest in this connection to note the behavior of the several indicators toward phosphoric acid and its soluble salts, as is shown by the following table:

INDICATORS.	Ortho phosphoric acid. H_3PO_4	Monobasic sodium hydrogen phosphate. NaH_2PO_4	Dibasic sodium hydrogen phosphate. Na_2HPO_4	Tribasic sodium phosphate. Na_3PO_4
Phenolphtalein...	Acid.	Acid.	Neutral.	Alkaline.
Turmeric.........	"	"	"	"
Blue litmus......	"	"	Alkaline.	"
Red litmus.......	"	"	"	"
Rosolic acid.....	"	"	"	"
Lackmoid........	"	Neutral.	"	"
Methyl orange...	"	"	"	"

III. TECHNIQUE OF TITRATION METHODS.

The titration methods employed at the Lawrence laboratory are for the most part based on the directions given in Sutton's text book on Volumetric Analysis. As details of procedure are a prominent factor with regard to the precision of the determination, the special features of the manipulation with phenolphtalein will be presented. Following this, reference is made to the manner of procedure with other indicators, which have been carefully studied with a view to showing, comparatively, the value of the several above-mentioned indicators.

Phenolphtalein.

This indicator is prepared by dissolving five grams of the commercial substance in one liter of fifty per cent. alcohol. It is not feasible to use this indicator on strips of paper as the alcohol quickly evaporates, leaving the powder. The colorless liquid, however, may be added in small quantities to solutions of an acid or neutral nature without any change of color, but alkalies quickly change it to a purple red. This change from no color to one of purple red makes the indicator a very satisfactory one, owing to the ease with which the eye detects the so-called end-point.

For the determinations of the degree of reaction of nutrient media it is the custom to put five cubic centimeters (practically five grams) of the solution into a six inch porcelain evaporating dish, together with forty-five cubic centimeters of distilled water. This liquid is boiled for three minutes, after which is added one cubic centimeter of the phenolphtalein solution. While the solution is still hot it is quickly titrated against a twentieth normal solution of caustic alkali.

As already mentioned, Dahmen (11) stated that this indicator is useless owing to the presence of carbonates, and of ammonia and its salts. On general grounds the point that this indicator is inaccurate under such conditions is well taken, but so far as its application to nutrient media is concerned it has been found that by proper precautions these objections may be overcome.

With regard to the amount of free and combined ammonia present in ordinary nutrient media at the times when their reaction is determined, it has been found that it does not exceed 0.003 per cent. Experiments show that this quantity is less than one tenth of that necessary to interfere with the accuracy of the method. It may be added that the reason why no ammonia is produced by the addition of alkali to the nitrogenous bodies is that at no time during the preparation is there an appreciable excess of free alkali present.

The chief point by which the presence of carbon dioxide is obviated is by the use of caustic soda instead of sodium carbonate for neutralization, as referred to beyond. It has been learned by actual experiment that the carbon dioxide is practically all removed by heat during the preparation of the media and at the time of boiling just prior to the titration. In

order to prevent atmospheric absorption of this gas the titration should be made quickly and in a hot solution.

The remaining precaution concerns the solution against which the nutrient media are titrated. All of the usual media react acid to phenolphtalein; hence the solution in question must be alkaline. Caustic soda serves the purpose well and the strength may be conveniently one twentieth normal, equal to two grams per liter. For the sake of prevention of interference from carbon dioxide in the standard solution as it meets the indicator, it is well to add a small quantity of calcium hydrate in order to precipitate this gas as calcium carbonate, and allow it to settle out in the reagent bottle. After this solution has been accurately prepared, care is necessary in order to keep it of uniform strength, and free from carbon dioxide. This is best done by placing the stock solution bottle on a shelf from which the liquid may be delivered into the burette by means of a siphon that is connected tightly with the top of the burette. In the tightly fitting stopper of the bottle are three perforations; one through which the siphon passes, and another for a U tube filled with concentrated caustic soda in order to absorb the carbon dioxide from all the air which enters the bottle. The third perforation is for a by-pass which connects with the siphon just above the top of the burette, and below the cock by which the flow from the bottle is regulated. The object of this is to provide for the entrance into the burette, as the solution is allowed to run from it, of air that has passed through the U tube and has had its carbon dioxide removed.

When the manipulation is carried out uniformly in the manner thus described, and with the constant employment of an end-point which has the same intensity of color, very satisfactory and closely agreeing results may be obtained by this method.

Other Indicators.

In the course of these investigations, experiments have also been made with the following indicators: red litmus, blue litmus, rosolic acid, lackmoid, turmeric paper, and methyl orange. Reference has already been made to the general characteristics of these indicators, and to the various ways in which they behave toward the phosphates. In the determination of the degree of reaction of media shown by the several indicators, all conditions at the time of titration have been kept as nearly as possible the same as in the case with phenolphtalein. These results are tabulated and discussed beyond.

The indicators themselves were prepared according to Sutton. Special attention has been given to litmus. Solutions of litmus added to the liquid to be titrated have been found to give less satisfactory results than the litmus paper. In addition to preparations made according to Sutton and to Mohr, as recommended by Dahmen (11), half a dozen different lots of litmus paper have been procured from various laboratories and

dealers. With litmus paper it has been found that the sensitiveness varies perceptibly, according to its age and the method of preparation.

IV. STANDARD METHOD FOR EXPRESSION OF THE RESULTS OF THE QUANTITATIVE DETERMINATION OF DEGREE OF REACTION OF NUTRIENT MEDIA.

Bacteriological literature contains three methods for the expression of the amount of acid or alkali added to nutrient media to influence the conditions of life of germs under examination, viz., (1) number of parts of medium to one part of acid or alkali; (2) percentage which the acid or alkali forms of the modified medium; and (3) the number of cubic centimeters of a normal solution of acid or alkali contained in one liter of the medium. Normal solutions of different acids and alkalies contain the same amount of the combining reagent; or, to be exact, they may be defined as solutions that contain in one liter the hydrogen equivalent of the active reagent weighed in grams, hydrogen being equal to one. The method of expressing the acidity or alkalinity of solutions in parts or in percentages is very awkward and misleading, owing to the fact that the equivalent weight differs in the case of the various acids and alkalies. I will illustrate this with oxalic and hydrochloric acids; normal solutions of these two acids, which combine with the same amount of alkali, contain, respectively, 63 and 36.4 grams per liter. If the acidity of these equivalent solutions should be expressed in parts, or in percentages, you will readily see that there would be an error of 73 per cent. For accuracy and convenience, the expression of acidity or alkalinity of culture media in numbers of cubic centimeters of a normal solution per liter is by far the best, and I recommend its universal adoption as a standard method.

V. QUANTITATIVE DETERMINATION BY MEANS OF THE VARIOUS INDICATORS OF THE REACTION OF CULTURE MEDIA AND THEIR INGREDIENTS.

In the following table there are presented the average results of a series of determinations of the reaction of meat infusions, peptone, gelatine and agar, with the use of phenolphtalein, blue litmus paper, red litmus paper, turmeric paper, rosolic acid, lackmoid, and methyl orange as indicators. The numbers refer to cubic centimeters of normal solution per liter, as has just been explained. No regular culture media, as they are prepared for use, contain an excess of free alkali. Neither is their reaction acid, in the ordinary sense of the term, but amphoteric as stated above, owing to the presence of acid salts and organic compounds, possessing both an acid and a basic nature. The reaction of media leans more heavily toward the acid than the alkaline side and the numbers below which have no sign refer to acidity, while the numbers with a minus sign refer to alkalinity.

Table showing Reaction of Media and of their Ingredients by the aid of various Indicators.

MEDIA.	Phenolphtalein.	Turmeric.	Blue litmus.	Red litmus.	Rosolic acid.	Lackmoid.	Methyl orange.
Meat infusion (450 grams lean meat digested in one liter of tap water for 24 hours in ice-chest)..	35	35	20	4	5	—4	—42
Merck's peptone (dry) 1 per cent. solution	16	16	7	2	3	—1	—9
Witte's peptone (dry) 1 per cent. solution	15	15	4	3	2	—2	—14
Sargent's peptone (dry) 1 per cent. solution	10	10	2	—1	- 2	—5	—14
Gelatine (best French brand) 10 per cent. solution (average)......	17	17	11	6	9	—6	—42
Agar 1 per cent. solution..........	0	0	0	—0.7	—0.7	—0.8	—1.6
Nutrient gelatine (meat infusion as above, 1 per cent. Merck peptone 10 per cent. gelatine).............	56	56	31	12	14	—10	—93
Nutrient agar (meat infusion as above, 1 per cent. Merck peptone 1 per cent. agar)..................	47	47	28	4	5	—4	—51

These results are placed on record chiefly for the sake of comparison of the relative value of the several indicators. There is one point of much practical importance, however, to which I wish to call attention. It is seen that agar is substantially neutral to all indicators, while the reaction of gelatine varies within wide limits, according to the indicator employed. Owing to the variation in the reaction of these two substances used for solidification, it will be noted that nutrient agar and nutrient gelatine solutions, which contain the same quantity and quality of peptone and meat infusion, and which have been made neutral to litmus, require different amounts of alkali to render them neutral to phenolphtalein. Thus with nutrient gelatine the change from the blue litmus-neutral point to the phenolphtalein-neutral point requires twenty-five cubic centimeters of normal alkali per liter, while for nutrient agar this number becomes nineteen. From this it follows that when the degrees of reaction of these two nutrient media are the same to litmus they are, when precisely considered, quite unlike.

Another point worth mentioning is that the percentage of total acidity indicated by litmus is one that varies within wide limits. It will be noted

that the reaction of different brands of peptone varies somewhat. With regard to the reaction of gelatine it may be added that with the same indicator the variation is very marked, even in the case of different samples taken from the same package.

The results obtained with turmeric correspond closely with those obtained when phenolphtalein is used. The latter is preferred, however, because the change of color in turmeric, from yellow to brown, is less satisfactory than from no color to purple red. Furthermore, the turmeric paper changes color rather slowly while with phenolphtalein the change is more nearly instantaneous.

VI. "DATUM POINT" FROM WHICH THE DEGREE OF REACTION SHALL BE UNIFORMLY CALCULATED.

In the use of culture media which contain ingredients of such variable reaction it is obvious that there should be adopted some fixed point to which all reactions shall refer. From the earlier statement that phenolphtalein is the best indicator it readily follows that the basis of calculations should be the point neutral to this indicator. This point has already been suggested by other investigators, working with this indicator, but its advantages have never been fully set forth. The first reason for its adoption is the fact that it takes into account the reaction of weak organic acids and of organic compounds which possess an amphoteric reaction, but in which the acid character predominates. This matter has already been discussed to some length, and further comment here is unnecessary.

The second reason for the universal adoption of this "datum point" is on account of its relation to the phosphates. It has been shown already that di-basic sodium hydrogen phosphate reacts neutral to phenolphtalein and turmeric, but alkaline to all other indicators. From our general knowledge it also appears that the phenolphtalein-neutral point means that no free phosphoric acid or its monobasic or tri-basic salts are present. That is to say, at this "datum point" all the phosphates are in the di-basic form (Na_2HPO_4). Results of experiments at Lawrence show that this acid salt may be added to culture media in amounts exceeding that naturally present in the media without causing any apparent influence upon bacterial development. These observations fall in line with those of von Lingelsheim (27), who, working under Behring's direction, found that the growth of the milzbrand bacillus ceased in blood serum only after the addition of di-basic sodium hydrogen phosphate to the extent of twenty per cent. It is instructive to note that under similar circumstances the same inhibitory influence was effected by eight per cent. of sodium chloride.

Facts show, therefore, that phenolphtalein is a thoroughly reliable indicator from a practical point of view, so far as phosphates are concerned. This is very satisfactory; but the evidence at hand leads us farther. It

shows that di-basic sodium hydrogen phosphate, which within all ordinary limits exerts no influence upon bacterial cultivations, reacts alkaline to all indicators mentioned in this paper except phenolphtalein and turmeric. This means that this acid phosphate, when litmus and other indicators, except the two just mentioned, are employed, prevents the addition of the proper amount of free alkali to effect neutralization. From this it follows, as the amount of phosphates in media varies to a considerable extent, that the reaction of media, from the bacteriologist's point of view, when litmus and other substances of its class are used as indicators, passes beyond accurate control.

VII. SOLUTION OF ALKALI TO BE USED FOR NEUTRALIZATION.

The hydrates and carbonates of sodium and potassium serve equally well for neutralization, so far as bacterial development is concerned. The hydrates are much to be preferred, however, on the ground of greater accuracy in the titration methods. Sodium hydrate is used in this laboratory, and it seems to be coming into general use.

Complications arise from the use of compounds of ammonium, owing to volatilization, and also from compounds of the alkaline earth metals, such as calcium and magnesium, on account of the precipitation of the salts which result from changes in the reaction.

VIII. OPTIMUM DEGREE OF REACTION FOR CULTURE MEDIA.

The information obtained from bacteriological literature with regard to the optimum degree of reaction is very small for the reason that most investigators upon the subject of reaction have occupied themselves chiefly with the amounts of acid or alkali to be added in order to arrest development. There can be no doubt that the great majority of pathogenic and non-pathogenic species of bacteria prefer as an optimum degree of reaction for gelatine a point lying somewhere between the litmus-neutral point and the phenolphtalein-neutral point. Upon reference to an earlier table it will be seen that the former point is much more acid than the latter. In fact, on an average it requires twenty-five cubic centimeters of normal alkali per liter to change a blue litmus-neutral gelatine to a point neutral to phenolphtalein. Or, in other words, a litmus-neutral gelatine reads 25, on an average, upon the scale has been described; and the optimum point lies somewhere between 0 and 25.

On this occasion we will confine ourselves to the optimum degree for the ordinary species of bacteria present in waters and in sewages. In a general way, however, I may add that the result of my observations indicate that germs of disease present no radical difference from water forms, with regard to degree of action.

Speaking in general terms the available data appear to warrant the placement of the optimum degree of reaction within narrower limits, between 10 and 20 of our scale. The former point was recommended by

Schultz (13) and the latter is the one which practically represents the reaction that has been used for nutrient media employed in the quantitative determination of bacteria in water at the Lawrence Experiment Station since the early part of 1892. I may say here that the use of litmus alone, as an indicator, was abandoned at Lawrence in July, 1891. For practical purposes the present method was developed in less than a year from that date, but the full reasons why phenolphtalein is so far superior to litmus were not thoroughly worked out until within the past year.

The degree of reaction has in all cases been kept under 20, and in some instances it has been found that 15 is a more favorable grade than 20. In this connection I may state that the influence of reaction appears to vary somewhat with different species and with the life-history of bacteria of the same species. The influence of reaction appears to be less marked in the case of the bacteria in sewage than of those in river, filtered, or ground waters. This may be due in part to the difficulty with which the very high numbers of bacteria in sewage are accurately determined. These statements will be of aid in studying the following table in which are presented representative average results of the quantitative determination of bacteria in Lawrence sewage, and in filtered and unfiltered Merrimack River water, upon media of varying but known degrees of reaction. Colonies were allowed to develop in plates which contained five cubic centimeters of medium and one cubic centimeter of water.

Table showing a comparison of Representative Results of the quantitative determination of Bacteria in Lawrence sewage, Merrimack River water, and Lawrence city (filtered) water on Gelatine of different degrees of Reaction, but with other conditions the same.

* REACTION.	LAWRENCE SEWAGE.		MERRIMACK RIVER WATER.		LAWRENCE CITY (FILTERED) WATER.	
	Bacteria per cubic centimeter.	Percentage which numbers are of that obtained with reaction No. 20.	Bacteria per cubic centimeter.	Percentage which numbers are of that obtained with reaction No. 20.	Bacteria per cubic centimeter.	Percentage which numbers are of that obtained with reaction No. 20.
40	168,000	6	100	1	4	2
35	448,000	16	400	3	7	3
30	1,225,000	45	600	4	16	8
25	1,720,000	64	7,800	55	84	46
20	2,688,000	100	15,000	100	184	100
15	2,870,000	106	13,300	89	169	92
10	2,726,000	101	8,100	54	112	60
5	2,625,000	98	6,900	46	80	43
0	2,234,000	86	5,800	38	66	35
—5	2,342,000	87	4,000	26	58	31
—10	2,230,000	82	3,200	21	48	26
—15	1,470,000	54	1,300	9	29	15
—20	1,290,000	48	500	3	15	8
—25	1,520,000	56	200	1	13	7

* Numbers refer to cubic centimeters per liter of normal acid or alkali necessary to change it to phenolphtalein neutral point. Minus (—) means an alkaline solution.

Dahmen (59), Burri (60), Chomski (61), Kleiber (63), and Reinsch (62) have all written upon the optimum degree of reaction for the development of water bacteria, but as they used a litmus-neutral point their results are of value only in a general way. It is instructive to note, however, that Reinsch (62) mentions that it has been proposed that the water analysts of the German Empire adopt a standard degree of reaction for their media which shall be obtained by adding to litmus-neu-

tral gelatine 1.5 per cent.* of crystalline sodium carbonate. According to Grahn (64) the practice of adding to nutrient gelatine, having a blue litmus-neutral point, 0.15 per cent. crystalline sodium carbonate has been officially adopted. This standard is subject to criticism on the grounds of inaccuracy, when viewed in the light of our more precise knowledge. But overlooking the fact that this standard refers to a variable datum point and assuming that German bacteriologists employed ingredients of the same quality as at Lawrence, it appears that the above standard would approximate 15 on our scale.

After weighing carefully the available evidence we may conclude that the optimum degree of reaction for the majority of bacteria lies between 15 and 20. As it is very urgent that some fixed point be adopted I venture to suggest that for quantitative water analyses when five cubic centimeters of medium are used 18 on our scale be taken as a standard. This means, of course, that such a solution would require 18 cubic centimeters per liter of normal alkali to render it neutral to phenolphtalein; and on an average about 6 to 8 cubic centimeters per liter of normal acid to make it neutral to blue litmus, but this last estimate is of necessity only approximate. For species work this proposed degree of reaction should be made 15 instead of 18 on our scale, owing to the fact that no water is added at the time of inoculation to reduce the acidity by dilution.

This proposed standard seems to be about the same as was adopted by Heim (10), von Lingelsheim (35), and the above mentioned writers in their investigations; it is also substantially the same reaction as is possessed by freshly drawn normal milk.

IX. METHOD OF ADDITION OF ALKALI IN NEUTRALIZATION.

All media when they are first prepared contain more acid than is called for by the optimum degree of reaction. There are two methods by which the change to the proper reaction may be effected.

1. The original method now in general use by which alkali is added to change the reaction from the original to the desired degree.

2. Timpe's (69) method by which alkali is added, as soon as all the ingredients are dissolved, to bring the solution to the phenolphtalein-neutral point, or better, to make it just slightly alkaline to this indicator. After heating and filtration hydrochloric acid is added to change the reaction to the required degree.

With media for general use there appears to be practically no difference in the two methods so far as efficacy for cultivation of bacteria and clearness of the medium are concerned. The second method has an advantage which comes into play under some circumstances, namely, the prolonged heating, which produces certain chemical changes, slightly increasing the

* From our own experiments, as well as the earlier writings of Reinsch it is clear that, by a printer's blunder, this quantity is made to read 1.5 per cent., instead of 0.15 per cent.

acidity, is always effected under fixed conditions with regard to reaction. The chief advantage of the latter method is on the ground of convenience in the preparation of several lots of media of different degrees of reaction; and this method has been adopted for regular work in this laboratory since January 1, 1895.

Gelatine and agar are unusually clear and bright after filtration at the phenolphtalein-neutral point. The addition of either acid or alkali makes them turbid, the turbidity varying with the amount added. Media of satisfactory appearance, however, are obtained without difficulty by ordinary methods of procedure. It has been found that the formation or presence of floculi does not appear to influence the degree of reaction.

X. LIMITS OF ACCURACY OF THE DESCRIBED METHOD AND THE INFLUENCE OF GLUCOSE UPON REACTION OF MEDIA.

There are two precautions to be constantly borne in mind in the practice of this method:

1. The solutions should be thoroughly mixed before samples for titration, etc., are taken from them.
2. Before the degree of reaction is determined care should be taken to see that the solutions possess the prescribed volume.

With the aid of these precautions, degrees of reaction of media for regular use, i. e., of optimum degree, have been obtained which usually agree within one with the prescribed grade on our scale. Occasionally this divergence reaches two, but it is rare that this number is exceeded. Slight discrepancies appear on either side of the fixed degree.

In about half a dozen instances during the past four years it has been noted that media have given results which did not correspond at all with the degree of reaction that they possessed. The reasons have not been fully worked out, but I am inclined to associate this observation with that made by Smith (72), who found that meat infusions do not, in all cases, contain muscle sugar (glucose). Owing to the acid fermentation of glucose by some bacteria, the absence of the carbohydrate would very probably make itself felt in some cases.

This observation on the occasional absence of glucose is one that is worthy of much more attention than it has received, at the hands of some bacteriologists, and the suggestion that glucose may be added with advantage, under such circumstances, to media used for some lines of work seems to be sound.

In concluding this paper on the results of four years' investigation upon this subject, it is my pleasant duty to acknowledge the valuable assistance of Mr. William R. Copeland during the past two years.

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WHAT METHOD SHALL BE ADOPTED BY WHICH FULL BENEFIT MAY BE DERIVED FROM MORPHOLOGICAL CHARACTERISTICS?

By Dr. T. M. CHEESMAN, College of Physicians and Surgeons, New York.

MAIN GROUPS.

As is well known, the bacteria, according to their morphology, have been divided into three great classes or groups, the cocci, bacilli, and spirilla.

SUBDIVISIONS.

Subdivisions of these classes have also been made, dependent upon the grouping of the individuals, among the cocci there being the single coccus, diplococcus, tetrad, sarcina, and streptococcus. The irregular and indefinite grouping which is denoted by the term staphylococcus is so entirely accidental that it seems to have little, if any, value as a basis for classification.

In the group of streptococci, it is customary to denominate the long and short chains by the terms "longus" and "brevis," and certainly this differentiation is a great convenience, but whether these characters are of sufficient permanence to render them of material value is a matter worthy of consideration.

The bacilli and spirilla being also found singly, or attached end to end, forming chains, or developing into threads which soon sub-divide into separate elements, offer characters which are of great practical value in classification, and are too well known to demand any further attention here.

In determining the grouping, however, I would say that it seems to me quite important to employ preparations made from fluid cultures, either hanging drop or broth tube cultures, as in this way the natural relation of the individuals to each other is less likely to be disturbed.

SHAPE (OUTLINE).

Very notable and quite constant differences in shape are to be observed among the three great classes of bacteria, which, as is well known, may be somewhat modified by the conditions under which growth has occurred.

The conditions which may lead to such modifications are known to be variations in the medium used for the culture, and the temperature at which it is grown. It would certainly seem that the most perfect forms

of the individual bacteria,—what might well be regarded as the most perfect morphological types,—should be obtained from a colony grown upon such a medium and at such a temperature as would lead to its maximum development. But, inasmuch as these conditions vary for the different species, it may, perhaps, be deemed more practicable to adopt one or more standard routine methods of cultivation of a species, for the purpose of adopting a morphological type. It is of great importance in determining morphology that too young or too old a culture should not be employed, for in the one case the individuals are imperfectly developed, and in the other distorted forms are apt to be found.

As to staining, it seems to me that greater uniformity should be observed. Many species stain easily and evenly with the ordinary dyes, while others stain with difficulty or unevenly; and there are a number of species that retain the color, even when treated with certain of the powerful decolorizing agents.

These differences in staining would indicate a difference in the organization or composition of the germ, and might be of greater differential value, if more generally applied.

STRUCTURE.

I do not feel qualified to speak of the intimate structure of the bacteria, but desire simply to submit this subject to you for consideration.

SIZE.

The individual bacteria, obtained from a pure culture, do certainly vary in size. Whether this variation is due to the unnatural conditions under which they develop, or to inherent causes, I do not know. It seems to me, however, quite important that the specimens used in determining measurements should be obtained from cultures grown under strict control, and further that a uniform method of staining should be employed to insure accuracy.

SPORES.

The formation of endogenous spores occurs regularly under certain conditions, or at certain stages of growth, in many species of bacilli, and they have been described as occurring also among the spirilla, but as to this, I do not know, as I have never seen them.

For the study of this character it is usually necessary to obtain preparations from a culture two or more days old, and I have always obtained better samples of spore, bearing bacilli from cultures upon solid media than from fluid cultures.

To differentiate the endospores from vacuoles and deposits within the bacillis, which may resemble them in appearance, the method of staining devised by Moeller will answer in most if not in all cases.

FLAGELLA.

Another marked and important morphological character of the bacteria is the flagellum, which may occur singly or in rows, or be found in tufts or bundles, upon the ends or sides of many and presumably of all of the motile species.

I have been unable to find any constancy in the number of flagella in any given species, although it is a rule which is not without exceptions, that a similar general arrangement of the flagella upon the bacteria may be noted.

In my efforts at staining flagella, the results have always been uncertain, and even when a well stained specimen is obtained, many fields are found containing isolated bacteria without the vestige of a flagellum being visible.

I have had some excellent results with Loffler's, van Ermengem's, and Bunge's procedures, the best average results being with van Ermengem's silver nitrate method, although even these are far from uniform, and I cannot but feel that no adequate method of staining the flagella has as yet been devised.

CAPSULE.

A capsule surrounding the bacterium may sometimes be demonstrated, but this character is not always a permanent one, nor is it always to be relied upon in cultures in artificial media.

In some cases the capsule stains easily with the ordinary dyes, but more often some special stain is required to demonstrate it.

No one method of staining is always successful, but I have had good results from the use of Gram's and Ziehl's methods, although my most uniform results have been obtained from employing the method devised by Welch for this purpose.

The greatest benefit may be derived from the characters that we have been considering only by having them fully developed and rendering them plainly visible.

For the development of the morphological characters it may suffice to carry each species through a single routine method of cultivation, upon a standard medium, or what seems to me more probable, two or even three routine methods of cultivation must be adopted, perhaps upon a single standard medium, before the typical morphological characters can be obtained.

For the demonstration of this morphology, various methods of staining must be resorted to. As has already been indicated, some of the technical methods are adequate to our needs; while others are not as perfect as could be desired; yet, I am confident that the adoption of a systematic, uniform plan, to be followed in all examinations will lead to much more uniform results than have been obtained in the past.

NOMENCLATURE OF COLORS FOR BACTERIOLOGISTS.

By E. B. SHUTTLEWORTH, Trinity College, Toronto, Ont.

Although the colors formed by bacteria are liable to be influenced by age and conditions of growth, they are, under similar circumstances, sufficiently constant to afford a valuable means for the identification of species. This has been practically recognized by the frequent references to color which are to be found in all bacteriological descriptions. Every worker must, however, have realized more or less difficulty in distinguishing and characterizing color, and in recording his observations in a manner satisfactory to himself, and intelligible to others. As individuals differ in their appreciation of color, and the eye of the observer is also liable to be affected by various influences, these difficulties may be expected to recur. A great deal, however, may be done by the employment of a systematic nomenclature, and by the selection of words to which a meaning as definite as possible has been attached. In any case such meaning can only be approximate, as the value of the terms used must be referred to imperfect and often erroneous mental impressions, or to objects or pigments, of which the color is always to some extent variable.

I have not yet had the opportunity of seeing the recently published work of Saccardo[1] on color nomenclature, but have with much interest consulted that of Ridgway[2], which is, however, more particularly adapted to the use of ornithologists. It contains a chromatic range unnecessarily large for bacteriological work, but may still be used with great advantage, more especially with reference to the plates by which the various modifications of color are represented. These have been executed with great fidelity, and with few exceptions have apparently resisted the effects of time. I have, therefore, when practicable, given the numbers indicating these colors, so that they may be employed in illustrating and comparing the various hues.

In the scheme of color which I have ventured to present I have interfered as little as possible with the words heretofore used in bacteriological descriptions, and have avoided a strictly scientific arrangement, preferring one of a more practical character, such as has been suggested by daily work in the laboratory. A rigidly scientific plan could be devised by few, and would not be followed by many, as the colors of bacteria are seldom primary or secondary, but consist of tints and shades, and modifications, of a complicated and perplexing nature.

It may be noted that it is, perhaps, better to accept the terms: tints, shades, and hues, as understood by artists—a *tint* meaning an admixture of

[1] P. A. Saccardo, Chromotanea seu Nomenclator Colorum Polyglottis. Friedlander, Berlin.
[2] Robert Ridgway. Nomenclature of Colors. Little, Brown & Co., Boston. 1886.

colors with white; a *shade*, colors with black; and a *hue*, color with color. The word *grey*, in an artistic sense, is limited to simple mixtures of black and white, while *gray*, though also cinereous and cool, is composed of colors of which blue and its related combinations are mixed with white, as blue gray, green gray, purple gray, etc. Yellow or red grays are properly browns. Bacteriological writers sometimes select one or the other of these terms, and many use them indiscriminately. I think it would be better to ignore these artistic niceties, and employ the word *gray* to designate cool colors of this class.

The colors of bacteria are generally much more easily reproduced in an oily than an aqueous medium, and seem more akin to those mixed with the former. This probably arises from the greater transparency of oil. Transparency and opacity modify very much the character of colors, and the transmission, refraction, reflection, absorbtion, or disposal of light, other than that giving rise to actual color, suggest some descriptive terms which, with certain convenient, though perhaps barbarous interpolations, may be thus formulated.

CHARACTERS DEPENDING ON DISPOSITION OF LIGHT, ETC.

Transparent.

Vitreous; transparent and colorless.

Oleaginous; transparent and yellow; olive to linseed oil colored.

Resinous; transparent and brown; varnish or resin colored.

Translucent.

Paraffinous; translucent and white; porcelaneous.

Opalescent; translucent, grayish white by reflected light, smoky brown by transmitted light.

Nacreous; translucent; grayish white, with pearly lustre.

Sebaceous; translucent; yellowish or grayish white; tallowy.

Butyrous; translucent and yellow.

Ceraceous; translucent and wax colored.

Opaque.

Cretaceous; opaque and white; chalky.

Dull; without lustre.

Glossy; shining.

Fluorescent.

Iridescent.

In compiling the following list of colors I have used any designation best suited to convey the intended meaning, and, for purposes of illustration, have introduced the names of well-known colored objects, or pigments, but, as far as possible, have tried to confine the terms to those commonly employed in indicating ordinary hues. The most difficulty is presented in characterizing colors in which yellow predominates. This has been realized by every bacteriologist, some of whom in their pub-

lished descriptions, use twenty-four words to express different modifications. The terms are often synonymous, or vague, and, as in the case of "bluish yellow," are not in harmony with correct ideas of the composition of colors. It has, no doubt, been remarked that the color of butter, or cheese, represents best the yellow chromogens. Such hues are produced by admixtures of yellow, red, and white.

The words *pale*, *light*, and *dark*, are used by artists to designate gradations of the same hue, but as the first two terms are liable to give rise to confusion, it will probably be better to substitute the word *medial* for *light*. If these degrees are applied to the terms on the left hand side of the list, they will, of course, give them a three-fold power of expression, and if one has a sufficiently good eye for color to use them in connection with the modifications in the right hand column, he will be able to indicate color with very considerable nicety. The colors in the right hand column are arranged as nearly as possible to show gradations from light to dark.

YELLOW AND ITS MODIFICATIONS.

Pure yellow (cadmium)	Primrose, VI, 13. Canary, VI, 12. Lemon (pale cadmium), VI, 11.
Greenish	Sulphur, VI, 14. Citron yellow, VI, 15. Olive yellow, VI, 16.
Reddish	Chrome, VI, 8. Deep chrome, VI, 9. Cadmium yellow, VI, 6.
Naples	Naples, VI, 18. Maize, VI, 21. Buff yellow, VI. 19.
Cream	Cream, VI, 20. Cream buff, V, 11. Buff, V, 13.
Ochreous	Golden ochre. Yellow ochre, V, 9. Raw sienna, V, 2.

ORANGE AND ITS MODIFICATIONS.

Orange	Orange, VI, 3. Orange chrome, VII, 13. Chinese orange, VII, 15.

RED AND ITS MODIFICATIONS.

Scarlet	Scarlet vermilion (mercuric iodide). Vermilion. Deep vermilion.
Crimson	Carmine. Deep carmine (fresh blood), VII, 6. Blood clot.
Brownish (brick)	Rufous, IV, 7. Light terracotta, IV, 11. Dark terracotta, IV, 14.
Wine (transparent)	Ruby. Claret. Garnet

Bluish pink	Rose, VII, 20.
Yellowish pink	Flesh. Salmon buff, IV, 19. Salmon, VII, 17.

PURPLE AND ITS MODIFICATIONS.

Reddish	Magenta, VII, 14. Aster, VII, 8. Auricula, VII, 3.
Bluish	Lilac, VII, 19, Violet, VII, 10. Royal, VII, 7.

BLUE AND ITS MODIFICATIONS.

Pure blue	Ultramarine, IX, 9. French blue, IX, 6.
Yellowish	Nile, IX, 23. Turquois, IX, 20.
Purplish	Smalt, IX, 8. Hyacinth, IX, 5.
Grayish	Glaucous, IX, 19. Verditer, IX, 22.
Blackish	Indigo, IX, 1. Marine, IX, 2.

GREEN AND ITS MODIFICATIONS.

Yellowish	Apple, X, 20. Olive, X, 18.
Bluish	Glaucous, X, 17.
Grayish	Sage, X, 15.
Blackish	Myrtle, X, 2.

BROWN AND ITS MODIFICATIONS.

Yellowish	Tawny olive, III, 17. Raw umber, III, 14. Coffee infusion (transparent).
Greenish	Olive brown, III, 9.
Tawny,	Light tan (ochreous), V, 7. Nut. Dark tan.
Reddish	Fawn, III, 22. Mahogany. Chocolate, III, 4.
Purplish	Liver, IV, 4. Claret brown, IV, 1. Maroon, IV, 2.

GRAY AND ITS MODIFICATIONS.

Greenish.	Olive buff, V, 12. Olive gray, II, 14.
Bluish	Pearl, II, 20. Lavender, II, 19. Lead, II, 15.
Blackish	Grey, II, 8. Grey, II, 6. Slate, II, 4.
Brownish	Smoke, II, 12. Mouse, II, 11.

MODIFICATIONS OF BLACK.

Purplish.
Bluish.
Brownish.
Greyish.

WHITE AND ITS MODIFICATIONS.

Yellowish..................................	Tints weaker than primrose, VI, 13.
Greenish..................................	" " " sulphur, VI, 14.
Cream..................................	" " " cream yellow, VI, 20.
Straw..................................	" " " straw yellow, VI, 17.
Pinkish..................................	" " " flesh.
Greyish..................................	" " " pearl grey, II, 20.
Brownish..................................	Dirty white.

I have ventured these suggestions with the hope that they will at least direct attention to the importance of this apparently trivial subject, and perhaps elicit a discussion, and thus lead to the perfection of a scheme of color towards which this paper is offered as a crude attempt.

ON THE PECULIAR METHOD OF BRANCHING IN THE GENUS CLADOTHRIX, AND THE VALUE OF THE SAME IN SYSTEMATIC BACTERIOLOGY.

By H. L. RUSSELL, Bacteriologist, Univ. of Wis. Agr'l Exp't Station, Madison, Wis.

In 1873 Ferdinand Cohn discovered, and in 1875 he described, a new type of a microörganism that he called *Cladothrix dichotoma*. This form was so well characterized by certain morphological peculiarities that he separated it from all other known types of bacteria. Not only was it made the type of a new genus but a new sub-class was also formed in which it was the sole representative.

The organism in question is a filamentous form that is often found in stagnant water and is marked by its peculiar method of growth. The filament or thread which is multicellular grows in a linear direction. Soon the continuity of this row of cells is broken and the apical end of the basal part of the filament resumes the function of growth. This causes a prolongation of the filament to be formed that usually diverges at an acute angle from the original thread and in this way the so-called branch is produced.

Cohn's figures (see Fig. 1) have stood for so long a time as an illustration of this peculiar method of branching that they are familiar to all. The genus and sub-class was founded primarily upon this single characteristic. Several other forms have since been included in this genus but much confusion has arisen between organisms that have genuine branches like the Streptothrix and other fungi, and those that are endowed with the peculiarity of branching as first discovered by Cohn. Attention can only be called in this connection to this fact, but the classification of these more highly organized bacteria is a subject that stands much in need of revision.

In the systematic classifications that have been proposed from time to time, the genus Cladothrix has been allowed to stand unchanged in its essential particulars and is usually regarded as the highest specialized type of bacterial life. In some of the proposed systems the absence of endospores and the presence of a gelatinous sheath have been added to the differential characters of the genus.

In studying, in 1891, the bacterial flora of the Mediterranean sea in the vicinity of Naples, one of the prevalent forms that came under my notice was a filamentous organism that possessed a growth peculiarity that recalled the cladothrix type. The filaments of the developing colony grew out as simple uniform threads arranged usually in a radiating manner. These threads at first were straight and continuous, but sooner or later they would break in two at one or more points. The broken ends

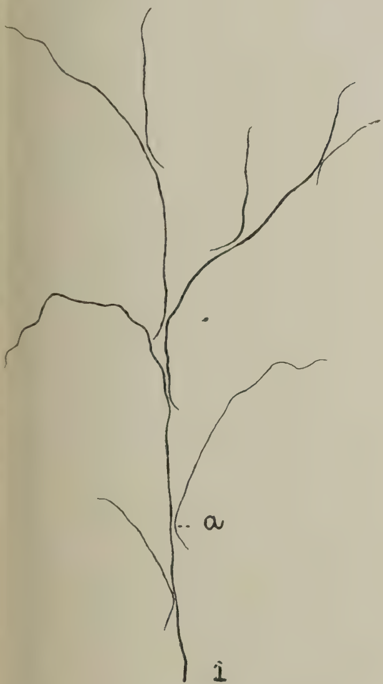


Fig. 1. Cladothrix dichotoma, Cohn, showing characteristic method of branching; *a*, shows backward growth.

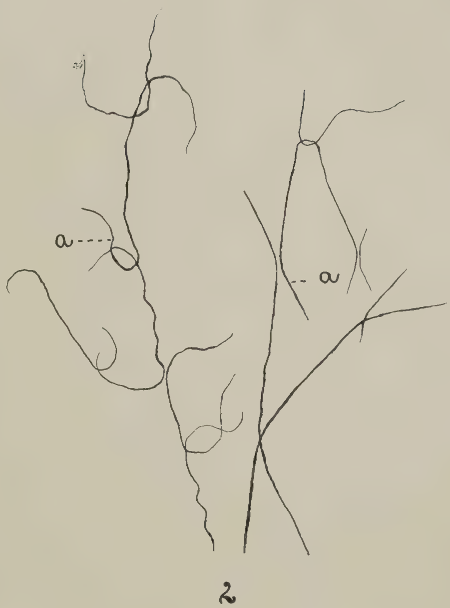


Fig. 2. Cladothrix intricata, Russell, *a*, show elongated backward growth.

of the separated filament continued to grow, the apical end of the proximal portion developing unusually more rapidly than the basal part of the distal end of the filament. Sometimes the developing threads would approximate each other, forming strands that might or might not be twisted around each other. In gelatin cultures especially, the growth of both ends of the broken filament usually diverged at an acute angle from the original thread. This gave rise to a series of branches of a peculiar sort that are closely related to those of Cladothrix dichotoma, the main difference being that in Cladothrix dichotoma, there was little or no growth of the basal end of the free filament (See Fig. 1, a) while in the Neapolitan form there was a marked backward growth of the ruptured end. See Fig. 2, a.

This peculiar method of branching has been considered exclusively a characteristic of the genus Cladothrix (omitting of course reference to certain algal forms like Scytonema and Calothrix) and for this reason the above species was placed under this genus and given the name of Cladothrix intricata on account of the convoluted and intricate twistings into which the filaments of the colony were thrown in the later stages of their development.

Coupled with the peculiar method of branching was the fact that Clad. intricata posessed genuine endospores and was also devoid of a sheath-like covering. In both of these respects it differed from the type species of the genus and could not therefore strictly be included within the limits of this genus without changing the characters of the class considerably.

Its action on culture media and its morphological characteristics showed that it stood closely related to the elongated filamentous forms in the present genus Bacillus, yet the presence of such a peculiar growth character, a peculiarity that easily distinguished it from other forms was the basis for its being included within the more highly specialized genus Cladothrix.

Since the discovery of this form, my attention has been especially directed toward the filament (—) forming bacteria to see if this peculiar method of branching was present in any other cases.

Until recently I have failed to note a parallel instance. A number of times I have observed the dissolution of the filament and the renewed growth of the released cells but usually this change was accompanied with the formation of bead like masses as in B. Zopfii, or a complex network in which no trace of the peculiar branching method was apparent. In examining an artesian well water recently, I had the good fortune to observe in two different cultures a number of colonies of a liquefying, filamentous organism that was endowed with exactly the same method of branching as had just been noted in connection with Clad. intricata. The filaments grew out into the gelatin in a continuous straight line but here and there along the line of the same, the thread was broken and the peculiar outgrowth from the two free ends was observed.

The isolation and cultivation of this organism on culture media showed it to be a form distinct from Clad. intricata.

The question now arises as to the distinguishing trait of the genus Cladothrix. In two different instances among the filamentous bacteria that culturally and morphologically are genetically associated with the genus Bacillus, this peculiar method of branching that heretofore has been considered as representative of the genus Cladothrix has been observed. Having establishing this point with two independent forms, we may fairly expect that with further study, other species will come to light that have the same peculiarity, and they must be classified and assigned their proper taxonomic position.

With Cladothrix intricata, the absence of a sheath and production of endospores made it vary from the typical characteristics assigned to the genus, but the presence of so distinguishing a character as the dichotomous branching was regarded of sufficient importance to place it in the more specialized genus. I am cognizant of the fact that Billet claims that Clad. dichotoma has genuine endospores, but they certainly do not conform to the ordinary type of such structures, and are not regarded as true endospores by other observers.

The more recent study of these two latter forms (Clad. intricata and the unnamed one) show that in all particulars they are essentially bacilli, although they possess this peculiarity of branching structure. For convenience, it might be preferable not to put them in the already overburdened genus Bacillus, but from the standpoint of genetic affinity, they certainly cannot be considered as closely allied with the type species of the genus, Cladothrix dichotoma.

It would seem, therefore, that the differential characteristic that the genus Cladothrix has so long enjoyed, must be considered as present in certain other filamentous forms of bacteria. I am inclined to look upon this method of branching as due largely to mechanical causes, as the intercalary growth of the cells of the filament produces a tension that is greater than the coherency of the same cells and consequently, the thread of cells is thrown into convolutions (spirilla according to Zopf) that ultimately result in a rupture of the filament and the production of the peculiar so called false branch.

(8) WHAT SHALL BE THE METHODS FOLLOWED IN DETERMINING THE RELATION OF BACTERIA TO TEMPERATURE?

By GEO. M. STERNBERG, M. D., LL. D., SURGEON GENERAL U. S. A.

Under this heading three principal questions present themselves: *First*, what is the most favorable temperature for development; *Second*, what are the extreme limits within which development occurs; *Third*, what is the thermal death-point. An answer to all of these questions is important in determining the characters of known species of bacteria, and in describing supposed new species or varieties. It is well known to bacteriologists that many of the saprophytic bacteria found in water will not grow at temperatures favorable for the development of certain pathogenic species, and by utilizing this knowledge the isolation of these pathogenic species, when they are present in a water supply, is greatly facilitated.

It is evident that the most favorable temperature for growth in suitable culture media must be determined by a series of culture experiments at fixed temperatures. This may be accomplished by the use of incubating ovens regulated for different degrees of temperature, or by immersing the cultures in a water bath the temperature of which is controlled by a regulating thermometer, and which may be quickly adjusted to any desired temperature. In a well-equipped laboratory one or more water baths, heated by gas controlled by a thermo-regulator, should always be kept ready for experiments of this kind. The highest temperature at which development occurs is to be ascertained in the same way—by culture experiments made at gradually increasing fixed temperatures until the limit at which growth occurs has been ascertained. For low temperatures it will be necessary to reduce the temperature in the bath or incubating oven by means of ice water or a refrigerating mixture, or to keep the cultures in a cellar or refrigerating chamber which has a constant low temperature.

In ascertaining the thermal death-point of a microörganism the following factors must be considered: *a*. The temperature, *b*. the time of exposure, *c*. the presence or absence of moisture, *d*. the presence or absence of spores, *e*. the age of the culture, *f*. the nature of the culture medium and its reaction, *g*. the amount of culture exposed and the character of the containing vessel.

a and *b*.

It is evident that one of the factors *a* and *b* should have a fixed value, for the higher the temperature the shorter will be the time required to destroy the vitality of a microörganism. In determining the thermal death-

point therefore, we may ascertain how long a time is required to destroy vitality at a given temperature, or how high a temperature is required to accomplish the same result in a given time. In order to compare the thermal death-point of different microörganisms it is desirable that a fixed time of exposure should be adopted. In the writer's experiments, made about ten years ago, ten minutes was adopted as the time of exposure and many bacteriologists have since adopted this as a standard time of exposure in making similar experiments. I would recommend that this standard be generally adopted.

As regards the limits of temperature within which determinations should be made, I am of the opinion that experiments made at temperatures varying by two degrees centigrade will give results sufficiently accurate for all practical purposes. Thus if a certain microörganism is exposed for ten minutes to 50°, 52°, 54°, 56°, 58°, and 60° C., and it is found that it develops in a suitable culture medium after such exposure to 50°, 52°, 54°, and 56°, but fails to grow after exposure to 58° and 60° the thermal death-point will be between 56° and 58° and would be stated as 58°, although further experiments might determine that it was somewhat less than this. In stating the results of my experiments I have always given as the thermal death-point the lowest ascertained temperature which destroys *all* the bacteria in the culture which is used in the experiments. Thus in the example given above, if a few colonies should develop after exposure for ten minutes to 56° and none at 58° the latter temperature would be stated as the thermal death-point. I think this is a good rule to follow and, as stated, consider the result sufficiently accurate for all practical purposes. It must be remembered that the thermal death-point varies within certain limits not only in cultures of the same microörganism from different sources, but also in different cells in the same culture. When we approach the limit at which vitality is destroyed we find that a certain number of cells may survive although the majority have perished; and these cells give evidence of diminished vitality by failing to develop in the usual time under favorable conditions. Thus if we make plates or Esmarch roll-tubes from a culture exposed for ten minutes to the temperatures above indicated we may find that at the end of twenty-four hours numerous colonies have developed from that portion of the culture exposed to 50° and to 52°; that a considerable number of colonies appear at the end of forty-eight hours in the plates or roll tubes to which had been added the portion of the culture exposed to 54°, and a few colonies appear at the end of four or five days in those from that exposed to 56°, while no colonies are seen in those to which the portion exposed to 58° was added. Or if our test is made in a liquid medium we will find the tubes from the lower temperatures clouded at the end of twenty-four to forty-eight hours; the tube at 56° may remain clear for three or four days and then become clouded from the tardy development of a few surviving cells, while the tube at 58° remains permanently clear.

What has been said will suffice to show that the test by cultivation, by which the destruction of vitality must be determined, should not be hastily made. The cultures, placed in an incubating oven, at a favorable temperature, should be preserved for *seven days* before the result of the experiment is recorded.

In making these experiments it is hardly necessary to say that the greatest care will be required in maintaining the bath in which the cultures are exposed at a fixed temperature, and that the accuracy of the thermometer employed must be verified in advance. It must also be remembered that the temperature may differ considerably in different parts of the bath. If in a water bath, heated from below, the cultures should rest upon the bottom while the thermometer showing the temperature of the bath was suspended at a higher level the results would be quite unreliable. The writer, in his experiments, supported the cultures at the same level as the thermometer, upon a glass table, placed in the bath for this purpose, and to insure uniformity of temperature in the bath stirred the water with a glass rod during the exposure. The temperature of the bath may be regulated by an automatic thermo-regulator, or by the personal supervision of the experimenter, who, with his eye upon the thermometer, controls the source of heat to secure the desired temperature.

(*b*) THE PRESENCE OR ABSENCE OF MOISTURE.

When not otherwise specified the thermal death-point of a microörganism should be understood to refer to the temperature which, in ten minutes time, destroys the vitality of all the cells in a culture when suspended in a liquid medium. The thermal death-point of bacterial cells in a dessicated condition subjected to dry heat is an entirely different question, and as shown by the experiments of Koch and Wolffhügel (1881) a much higher temperature is required to destroy vitality under these conditions.

(*d*) THE PRESENCE OR ABSENCE OF SPORES.

The spores of bacilli have a far greater resisting power to heat than the vegetative cells and the question of their thermal death-point must be determined independently. As many of these spores resist the boiling temperature we may desire to acertain the time required for their destruction at this fixed temperature, rather than the temperature above the boil-point which will destroy them in a given time. As a rule it will, in my opinion, in the case of spores which resist the boiling temperature, be best to state the time required for their destruction by a temperature of 100° C. In the case of spores which are destroyed by ten minutes exposure to a lower temperature I would determine the thermal death-point exactly as recommended for non-sporebearing microörganisms.

(*e*) THE AGE OF THE CULTURE.

The thermal death-point depends to some extent upon the age of the culture. In old cultures the vital resisting power of the cells to heat or to chemical agents may be more or less diminished. We therefore require a standard as to the age of the culture. For bacteria which will grow in our standard, neutral, "flesh-peptone-solution," I would recommend the use of a culture in this solution which has been kept in the incubating oven at 37° C. for forty-eight hours. Bacteria which fail to grow in this solution may be cultivated on solid media, or otherwise, at the temperature most favorable for their development, for the same period—forty-eight hours. In order to secure uniform conditions I would recommend that three öse of the culture be added to five c.c. of distilled water for the purpose of the experiment.

(*f*) THE NATURE OF THE CULTURE MEDIUM AND ITS REACTION.

If a small quantity of the culture is added to five c. c. of distilled water as above proposed, the nature of the culture medium will not be so important, but when this is directly exposed, without dilution, the result will to some extent be influenced by the nature of the culture medium and especially by its reaction. A lower temperature is required to destroy vitality when the medium is decidedly acid than when it is slightly alkaline or neutral.

(*g*) THE AMOUNT OF CULTURE EXPOSED, AND THE CHARACTER OF THE CONTAINING VESSELS.

The larger the amount of the culture and the thicker the walls of the containing vessel, the longer will be the time required for bringing it up to the temperature of the bath. It is therefore desirable that these conditions should be as nearly uniform as possible. We have suggested above 5 c. c. of water containing in suspension three öse of a forty-eight hours culture. This should be placed in test tubes of standard size and thickness—say tubes of five-eighths of an inch in diameter[1] (Eimer and Amend's catalogue, No. 8270.)

In the writer's experiments capillary tubes containing a very small quantity of culture, not diluted, were used. The contents of such tubes quickly attain the temperature of the bath and they have certain other advantages. But it is believed that it will be best to recommend for general use the tubes of German glass which are always on hand in bacteriological laboratories, specifying only the diameter of the tube and the quantity of fluid (5 c. c.) which it should contain. It will, of course, be necessary to have a bath of sufficient depth to have the contents of the tube well below (two or three inches) the surface of the water, and at the same time not too near (two or three inches) the bottom of the containing vessel.

[1] About sixteen millimeters.

HOW IS VARIABILITY IN BACTERIA TO BE REGARDED?

By J. GEORGE ADAMI, M. A., M. D.

Late Fellow of Jesus College, Cambridge; Professor of Pathology in the McGill University, Montreal.

If we take any single microbe in pure culture and grow it on different media we are fairly certain, on careful examination, to observe differences in the sizes and characters of the individual microbes according to the medium employed. The differences may be small, and not sufficient to arrest the eye upon casual examination, but there they are nevertheless. If now we proceed further, and modify the temperature of growth, the reaction of the medium, the amount of oxygen supplied, the pressure of the superincumbent air, or again, if we add minute quantities of substances which in larger amounts are capable of destroying the microbes, by these and yet other methods we can produce greater modifications, both in the appearance of the bacteria, and metabolic processes by them set up. We can augment or inhibit the productions of pigment, can prevent the development of certain ferments and products of enzyme action, can educate bacteria which never manifested any tendency to break up gelatine, for example, to liquefy that substance, and we can advance yet further. We can, through hundreds of generations, imprint certain characteristics upon microbes, so that growing in the ordinary media of the bacteriologist they show for long no tendency to revert to their original characters, and, indeed, are regarded by those who have grown them as being permanent modifications. Let me here cite the two most remarkable examples. By growing the anthrax bacillus in broths containing minute quantities of disinfectants, Roux was able to obtain bacilli which, returned to ordinary media, showed for months, and I believe years, a total lack of the power of forming spores. Recently Arloing, by subjecting these same anthrax bacilli to the action of air under pressure, has obtained a race of bacilli in which the spores, instead of developing in the central part of the rodlets, are terminal, so that the spore bearing bacilli are nail shaped. This latter form is perfectly harmless, and incapable of killing animals when inoculated into them. It would be possible for me to give a very long list of observations upon the production of more or less permanent variations in the properties of individual species of bacteria, but this would be away from the present purpose of this communication. What I wish to impress upon you is that experimentally in the test tube it is a matter of comparative ease to vary the properties of the bacteria, to vary them to such an extent that were we to be given the modified forms without any information as to the previous treatment undergone by them or their predecessors it would be impossible by the ordinary methods employed for the differen-

tiation of species to arrive at any other conclusion than that we were dealing with a form of microbe totally distinct from the parent species,—in fact, with a totally distinct species.

If this be true of experimental modifications how are we to become assured that many of the closely allied forms which we encounter in the bacteriological study of water, air, soil, and cases of disease are truly separate species? How can we protect ourselves against a multiplication of described species, as unwise and depressing as it is scientifically false? We know from experiment that comparatively slight changes in environment, acting over a long period, impress modifications upon bacteria quite as surely and strongly as do great alterations acting for a short time. We know that time after time in the study of the bacteria of water, as in those of disease, we encounter forms which, while in general harmonizing, depart in some particulars from the classical descriptions of well-recognized species. How are we to regard these forms—as distinct species, or as modifications of what I may term the type brought about by the former condition, namely, by the continued action of a slight alteration in environment?

I will not here dwell upon the numerous examples that might be quoted in connection with the bacteria of disease. The perplexing group of forms which approximate to the typhoid bacillus, the group of diphtheria and pseudo-diphtheria bacilli, the series of pathogenic spirilla which have been isolated from cholera patients, and from waters which have possibly been contaminated by the dejecta of cholera patients, and even more perplexing than all of these, the cluster and chain cocci of suppuration, of which so far as I can see no two cultures obtained from consecutive patients present quite the same characteristics of growth, pigment formation, liquefaction of gelatine, and pathogenic powers. We are becoming hardened to the departures from type in connection with these pathogenic bacteria and I think I shall not convey a false impression if I state that the tendency among those dealing with the bacteriology of disease is to regard closely allied forms possessing pathogenic properties of like value not as separate species but as races and varieties of a common stock. This may not in itself be a scientifically accurate stand to take, for in most cases no attempt is made to demonstrate the relationship. Nevertheless to take the opposite view, and regard each form that departs in any one particular from the generally accepted description of the text-books as constituting a separate species, is to build a bacteriological tower of Babel.

In the bacteriology of disease we have then one important preventive against undue multiplication of species, namely, recourse to inoculation and reproduction of some well-recognized series of pathological processes. The method is imperfect and not of universal application even in the restricted province of pathogenic bacteriology. Nevertheless it has shown itself most serviceable.

In the bacteriology of water there is no such generally useful test or

touchstone and in its absence there is confusion of tongues and a veritable chaos. There are no generally accepted laws defining what is to constitute a species and what is to be described merely as a variety. Thus the all-important question to be decided at the present moment in systematic bacteriology is how this chaos is to be changed into an orderly arrangement.

As has already been suggested, the first step must be in the direction of the establishment of a system of broad groups, each group containing forms that have many important features in common. If we can allocate any form which we are investigating to its group, and can emphasize the fact that it is a member of a group rather than an isolated species, and distinct entity, a Micrococcus Brunonus, Bacillus Jonesius, or Spirillium Robinsonium, we shall make a notable advance.

And I think we can go further than this. It is a matter of common knowledge that the varieties of the domestic animals and pets, and of plants brought about by human selection, are not stable. If they are permitted to revert to a state of nature, they either die out, or in the course of a very few generations regain largely or entirely the characters of the original stock. And with bacteria the same is very largely true. The fact that has most impressed me in endeavoring to produce artificial varieties of bacteria, has been that upon return to ordinary media there is this same marked tendency to revert to the characteristics of the original form. It may be weeks or it may be months before the change is well marked. There may have been hundreds of "generations," or multiplications of the modified bacteria before the reversion is complete, but so noticeable is the tendency that personally I am inclined to believe that in all cases it will sooner or later manifest itself. This, I know, is not the opinion of those who, like Roux, have produced powerful modifications on one or other forms. They regard them as truly permanent; but even these would, I fancy, agree with me that permanent modifications are difficult to establish, and that the tendency to reversion is so general that it may be employed as a means for determining whether a form isolated from water or other medium, and presenting general agreement in its properties with those of some recognized species, while departing from them in other points, is to be regarded as a different species or as a variety.

The means I would here recommend is the simple, though possibly tedious, one of keeping doubtful forms under observation for some months upon standard media.

Careful study of a form of microbe at and immediately succeeding its isolation from one or other medium is eminently fitted to demonstrate the individual peculiarities of that form. It is at such a period that the differences and departure from allied forms are most pronounced.

On the other hand, if allied forms be grown on ordinary standard media, which have not been prepared in order to accentuate differences, upon standard beef broths—agar or gelatine,—then the effects of the

continuance of a common environment will eventually remove those characteristics which may be termed temporary impressions due to previous modified environment, and in the course of a few weeks or months forms that are but races will revert to type.

Let me give an example: It may be remembered by many here present that Cunningham of Calcutta isolated as he considered at least a dozen separate species of spirilla from genuine cases of cholera—and forthwith jumped to the conclusion that Koch's Spirillum Choleræ Asiaticæ could not be considered the cause of the disease. He described fully these various species and showed how each separate form differed in color production, rate of growth in, and of liquefaction of, gelatine, appearances upon potato, etc. These forms were sent to Berlin for verification. There it was found that the great majority in the course of time reverted to a form indistinguishable from the growths of Koch's Spirillum preserved in the laboratory[1].

Not to dwell too fully upon this, I would recommend:

1. That in order to emphasize as much as possible the individuality of any given form isolated, it be studied upon various media so soon as isolated.

2. That to determine the relationships of such a form successive growths should be made upon the ordinary standard media for not less than a year, control and parallel growths of the form to which it appears allied being conducted at the same time and on the same media.

3. That if at the end of the year the differences between the two forms persist, then the form examined must be classed as a sub-species.

4. That otherwise the form is shown to be definitely a variety.

5. That all who describe new species should be urged to afford a second description twelve months later in the same journal as that in which their first communication appeared, this second description stating accurately how far the forms have become modified by continued growth on ordinary standard media.

In this way I think that a small but satisfactory advance might be made.

[1] In justice to Cunningham I ought to add that, in a recent communication not seen by me until after this paper was delivered, he declares that he has found the characters of his forms to remain permanent.

OPENING DISCUSSION ON "WHAT NEW METHODS CAN BE SUGGESTED FOR THE SEPARATION OF BACTERIA INTO GROUPS AND FOR THE IDENTIFICATION OF SPECIES."

By J. J. MACKENSIE, B. A.

Toronto, Bacteriologist of the Provincial Board of Health of Ontario.

Gentlemen,—In opening the discussion upon the subject assigned me I wish to speak more especially in regard to a branch of bacteriological technique, which, perhaps, should properly come under Subject 3. This is the subject of synthesized media. As a matter of fact, the character of the medium is all important for any method which will serve to separate bacteria into groups, for these methods must almost necessarily be based on some chemical reaction or change in the culture medium.

It is hardly necessary to refer again to the necessity of exactitude of composition in order to obtain accurate results and it is not possible to obtain such with the materials in use in our laboratories at present. We know very little of their chemical composition, except that they vary exceedingly, depending upon all sorts of conditions, over which we have no control.

If we consider the foundation of all our media, beef broth, we are compelled to acknowledge that we are dealing with an unknown quantity. As prepared in the laboratory, it contains, as a source of nitrogen nourishment, only traces of albumenoids and peptones with a small quantity of gelatinous material derived from connective tissues, and the nitrogenous extractives, chiefly kreatin and xanthin bodies.

The carbon nourishment is also very small, in the form of sugar and organic acids, and the only remaining materials are the inorganic salts. All these chemical substances are just those which vary most, depending upon the condition before killing the animal and the treatment of the meat after death. The nutritive value of these substances is, of course, not in question, simply their great variability.

If we put aside the traces of albumenoids and peptones present in bouillon, all the other substances we are able to obtain in a chemically pure condition and, by their use, make up a nutritive medium of which we know the exact composition and from which we can obtain reactions upon which we may depend. The only difficulty is to obtain such a combination of these substances as to construct a medium of equal nutritive value with bouillon.

There is another substance present in our liquid culture media which is also equally uncertain in composition, that is, the peptone; it is

undoubtedly the most important element in our culture media from a nutritive standpoint, and it is exceedingly unfortunate that its composition is so variable. Practically all the commercial peptones contain only small quantities of true peptones, the bulk of the material being albumoses of various kinds. Witte's peptone, which Kühne found to be one of the most satisfactory, is almost entirely made up of albumoses. In order to obtain a sufficient quantity of peptones for study, Kühne had to submit Witte's peptone to prolonged digestion for several weeks. At one period he and Chittenden found that Witte's *peptonum sicum* contained chiefly hetero- and proto-albumoses; at another, Neumeister found that it consisted chiefly of secondary deutoro-albumoses.

In addition to these little known substances, the commercial peptones all contain varying quantities of other organic compounds such as amido acids, many of which are probably impurities derived from the stomachs used for the preparation of pepsin.

Finally, various inorganic salts may be present. Gessard has shown the presence of phosphates in many samples of peptones and Lunkewicz has noted the presence of traces of nitrates in Witte's and other preparations. These two last impurities are of special importance, as Gessard claims that the fluorescence of Bacillus pyocyaneus and other fluorescent forms is due to the presence of phosphates, whilst the presence or absence of nitrates in the peptone used, must be of considerable importance in the production of the indol reaction.

This uncertainty in the composition of commercial peptones is a great drawback to their use where exact results are desired, and it seems to me that, whether we are desirous of cultivating bacteria under constant condition or of studying some specific physiological chemical reaction, we must, if possible, exclude them. It is unfortunate, on account of their high nutritive value, but no other way seems possible.

In regard to the other two substances which chiefly enter into our nutritive media, gelatine and agar-agar, little can be said. They are also extremely variable but we cannot well get on without them. The only thing for us to do is to obtain them in as good a condition as possible.

The gelatine is, perhaps, most apt to vary, and this variation may be in two ways, either physically or chemically. Physically, it varies in the melting and solidifying point, dependent upon the length of time it has been treated during preparation. In photographic work where the physical character of the gelatine is of great importance, two or three varieties are used, a hard, medium, and soft, depending upon the purpose for which they are intended. In bacteriological work this physical character of hardness or softness is of considerable importance in determining the form and contour of the colonies in plate cultures. As a rule, I think, a fairly hard gelatine should be used, but I want more especially to call attention to the fact of variation and the necessity for obtaining a gelatine of as constant a quality as possible.

As to the chemical impurities present, they vary with almost every

brand, depending upon the method used by the manufacturer. The chemical character which most frequently attracts our attention in bacteriological work is the acidity, and I think that *a priori* we may set down a gelatine as being relatively pure which has a low degree of acidity. If it were possible to substitute silica jelly in solid media, the final step would be made in the formation of an ideal non-variable culture-medium, but the tedious and troublesome process of preparation will always be a bar to its use for general work, with the additional fact that if we were to exclude gelatine, we would exclude the all-important factor of peptonization of the jelly, which is so necessary in the diagnosis of species.

I propose before noticing any of the newer methods for the separation of bacteria, to give a brief account of the literature upon the subject of synthesized media, as that subject has interested me much lately, and also, to give a few experiments of my own with these media, which I have been able to make in the interval of routine public health work.

Some of the earliest work in bacteriology was performed with synthesized culture media, and we left these media, largely on account of the greater ease with which media of an animal character could be prepared, and perhaps, also, on account of the greater nutritive value of the latter.

It would not be possible to outline, even, all the earlier work with such media, but the first to use them in comparatively recent times was Fermi in a series of researches upon the enzymes of bacteria. He used a modification of Naegeli's culture medium, and evidently found that a large number of bacteria grew well in it. Fermi's solution contained the following ingredients :

Distilled water	1000 c. c.	
Magnesium sulphate	0.2 grammes.	
Acid Potassium phosphate . . .	1.0	"
Ammonium phosphate . . .	10.0	"
Glycerin	45.0	"

De Schweinitz of Washington made use of the same medium for the cultivation of the hog cholera bacillus, and found it to grow well and characteristically. He, however, carried it a step farther and substituted it for peptone beef-broth in preparing agar-agar. On this solid medium both the hog-cholera bacillus and the swine plague bacillus grew well. By adding peptone and increasing the glycerin to seven per cent. he prepared a culture medium on which the bacillus of tuberculosis grew better than on glycerin agar. The bacillus of glanders also grew well with five per cent. glycerin and the medium allowed to remain slightly acid. These are the only micro-organisms which de Schweinitz speaks of in his article.

Gessard, in his researches upon the fluorescigenic function of bacteria, more especially in Bacillus pyocyaneus, used a proteid free culture medium

very similar to that which Hueppe used in his studies on blue milk. Gessard's medium had the following composition:

Water	1000 c. c.
Ammonium succinate	10 grammes.
Potassium phosphate	5 "
Magnesium sulphate	2.5 "

Even the magnesium sulphate could be omitted without materially affecting the production of fluorescence. Besides the above solution he used also another in which lecithin was substituted for the succinate of ammonia.

Winogradsky, Frankland, and others, in their work upon the organisms of nitrification have used proteid free nutritive media, but on account of the special character of their work and the biological differences, between nitrifying bacteria and ordinary saprophytic forms, it is hardly to be expected that their nutritive media could be used in the general study of water bacteria. The most important result which their work shows, is the marvellous synthetic power which these forms have in spite of the absence of chlorophyll or anything of a similar character.

In 1893 Uschinsky published an account of a synthesized culture medium in which he found that a number of bacteria grew well. The forms which found this medium favorable for their development were hog-erysipelas, cholera, diphtheria, peri-pneumonia bovina, tetanus, typhoid, and others. Some of these forms grew better, even, than in peptone-beef-broth. His medium contained the following ingredients:

Water	1000 c. c.
Glycerin	30-40 grammes.
Sodium chloride	5-7 "
Calcium chloride	0.1 "
Magnesium sulphate . . .	0.2-0.4 "
Bi-Potassium phosphate . . .	2-2.5 "
Ammonium lactate	6-7 "
Sodium asparaginate . . .	3.4 "

This was a slight modification upon the medium, first used by him, chiefly in containing a lower percentage of glycerin and in containing asparaginate of soda.

This culture fluid of Uschinsky's has been made use of by a number of observers, but always for special purposes, such as the study of some particular form, and many have not been able to confirm Uschinsky's favorable results for some forms. Brieger tried it in his investigations upon tetanus toxin but found it useless.

Kühne in his exhaustive study of tuberculin found it necessary, in order to avoid the confusion arising from unknown substances in the nutritive fluid, to make up a proteid free fluid, and proceeding upon the assumption that only the mineral substances in beef extract were of any nutritive

value he constructed a nutritive medium as follows: a weighed quantity of the ash of Liebig's condensed meat or a substitute for it, made up of chemically pure salts, was used as a basis, to which was added a number of organic compounds. This culture fluid was exceedingly complicated in character and from the knowledge which we now have, altogether too much so. The ash substitute was made up as follows:

Sodium chloride	16.0	grammes.
Magnesium sulphate	3.5	"
Burnt gypsum	1.5	"
Burnt magnesia	2.5	"
Dry potash	62.13	"
Soda	7.35	"
Ferrum redactum	6.20	"
Phosphoric acid (1.2 Sp. Gr.) . .	95.0	"
Lactic acid (1.2 Sp. Gr.) . . .	50-60	"

These were added to 600 c. c. distilled water and boiled, and 12 c. c. of the solution was about equivalent to 10 grammes of Liebig's extract, and was sufficient for 1 litre of culture fluid. To the litre of culture fluid he added:

Leucin	4	grammes.
Tyrosin	1	"
Asparagin	2	"
Ammonium mucate	2	"
Taurin	0.5	"
Glycerin	40.0	"
Sodium chloride	5.0	"

Kühne did not carry his investigations very far as to the comparative value of the different substances in this fluid, but he went far enough to see, that the most important organic compounds were asparagin and glycerin.

Kühne's work upon the nutrition of the bacillus of tuberculosis was extended by the exceedingly valuable researches of Proskauer and Beck. They found at once that it was possible to greatly simplify the culture fluid, and that the bacillus of tuberculosis was not at all exacting as to the character of the organic compounds which would serve either as nitrogenous or carbonaceous food. It would not be possible to give at any length the results of their researches, but a few of the more important points might be cited. Taurin had a restraining action upon growth and consequently was discarded. Tyrosin was of little value and was also discarded. The amido acids, such as leucin, asparagin, and alanin, were all good sources of nitrogen. The xanthin bodies were useless; lecithin was also of no value. Finally various ammonia salts, both inorganic and organic, were found to be excellent sources of nitrogen when combined

with the proper carbon food. As carbon nourishment could be used citric acid, tartaric acid, mucic acid, and a large number of similar compounds, also the sugars, such as glucose and mannose, and the di-saccharoses, cane sugar, milk sugar, malrose, and raffinose. Finally, such polyatomic alcohols as mannite and dulcite proved to be excellent sources of carbon. In all these various solutions the presence of glycerin was absolutely necessary, but the percentage was reduced to 1.5 owing to the fact, which the authors discovered, that only about that percentage was used up after a long period of growth. The mineral substances were similarly reduced in number, so that all that was necessary was a phosphate and a sulphate, usually magnesium sulphate. They finally succeeded in obtaining a medium of such simplicity that it holds out great prospect for similar success in the cultivation of water bacteria, from which we should not expect to find such strict demands as to the character of their food supply as from the bacillus of tuberculosis. This simplified medium has the following composition:

Commercial ammonium carbonate .	0. 35	per	cent.
Primary potassium phosphate . .	0.15	"	"
Magnesium sulphate	0.25	"	"
Glycerin	1.5	"	"

On this exceedingly simple mixture the bacillus grew badly for the first six weeks, then a rapid growth began, resulting in the covering of the whole surface of the fluid in a very few days. The reason for the retarding of the growth during the first six weeks they thought rested in impurities in the carbonate of ammonia, but the results were not sufficiently complete to decide positively.

Uschinsky's medium they found unsuited for the growth of the bacillus of tuberculosis.

Proskauer and Beck promise a continuation of their interesting work, which will be looked for impatiently by all those who are interested in the biology of bacteria.

In the latter part of 1894 Fraenkel of Marburg published the results of some researches of his upon the use of synthesized media in the cultivation of bacteria. I have not been able to obtain access to the paper itself, but I have seen two fairly full *referate* which give the most important points. He uses Uschinsky's formula as a basis, and his medium has the following composition. Calcium chloride is omitted in order to avoid cloudiness in the solution. Magnesium sulphate was also found to be unnecessary. The other substances used were:

Ammonium lactate	6	grammes.
Potassium di-phosphate	2	"
Sodium chloride	5	"
Sodium asparaginate	4	"

Instead of the latter could be used asparagin. A large number of micro-organisms both saprophytic and parasitic grew well in this medium, for instance, Bacillus coli communis, Bacillus pyocyaneus, Bacillus Friedlander, glanders bacillus, and all the vibrios; very slight growth of anthrax or Streptococcus pyogenes, scarcely at all in typhoid, diphtheria, or the staphylococci, and tetanus, hog erysipelas, mouse septicaemia, and chicken cholera refused to grow. Fraenkel does not confirm Uschinsky's results, even when the solution was made up exactly after his formula. The presence of sulphates was claimed to be unnecessary even for bacillus of tuberculosis, but Proskauer in his *referat* in the Chemisches Central-Blatt points out that sufficient sulphate would be present as an impurity in the soda used for neutralization, to supply all that was necessary. Fraenkel was unable to render his fluid more favorable for the development of the forms mentioned above which grew badly or not at all. The chromogenic bacteria tried, developed their characteristic pigment well.

Maassen has quite recently published an account of another proteid free culture medium which he used especially for the study of vibrios. It is made up in the following manner: Seven grammes of malic acid are dissolved in 100 c. c. of distilled water. This is exactly neutralized (to litmus paper), with a seven per cent. solution of pure potassium hydrate. It is then made up to 1,000 c. c., with distilled water, and there is added

Asparagin	10	grammes.
Secondary sodium phosphate . .	5	"
Magnesium sulphate	2.5	"
Sodium hydrate	2.5	"

After these are all dissolved there is added 0.01 grammes of calcium chloride. This standard solution is completed by the addition of carbon nourishment in the form of glucose, lactose, cane sugar, glycerin, or other similar compounds in varying amounts. Maassen found it exceedingly favorable for the cultivation of vibrios, but did not try it for other bacteria.

These then are the chief investigations which have been made into the use of synthesized media in recent years.

It will be noticed that all these synthesized nutritive media have been made up, practically, on the lines of Pasteur's, Cohn's, and Naegeli's solutions, and that the same substances which these earlier observers found of special value are included in the various fluids which have been mentioned above.

In almost every case the investigation into the value of these synthesized media has been made with some special line of research in view, not with the idea of obtaining a culture medium of general application. As a result, most of the observers have simply worked with fluid media; de Schweinitz in the case of hog-cholera, swine plague, tuberculosis, and glanders, however, combined the fluid with agar, and Voges combined a

slight modification of Uschinsky's medium with agar for the cultivation of the cholera vibrio.

One of the most serious drawbacks to the use of these media is the tendency which they all have to form crystalline precipitates, most frequently ammonium magnesium phosphate. In fluid cultures this is of little consequence except in the loss of nutritive salts as a result of it, but in solid media it becomes very disturbing, as the crystallization does not take place at once, but continues for many days, and the appearance of the medium is spoiled. This precipitation depends upon the alkalinity of the fluid, and where the latter is very alkaline, it must result in almost complete loss of either the ammonium or of the phosphate, which cannot be without influence upon the organisms growing in it. The relationship between the alkalinity of the culture medium and the precipitation of the triple phosphate is shown by the following experiment. A culture fluid was made up as follows, based upon one of Proskauer's:

Acid ammonium tartrate . . .	0.2	grammes.
Bi-potassium phosphate . . .	0.5	"
Magnesium sulphate	0.2	"
Sodium chloride	0.1	"
Potassium sulphate	0.25	"
Lactose	0.4	"
Glycerin	1.5	"
Water	100.00	"

Ten c. c. of this fluid required 0.45 c. c. of normal soda to give a distinct color with phenolphthalein. Eight tubes were filled ten c. c. each, with the unneutralized medium, and normal soda added as follows:

No. 1.	0.05 c. c.
No. 2.	0.1 c. c.
No. 3.	0.2 c. c.
No. 4.	0.3 c. c.
No. 5.	0.35 c. c.
No. 6.	0.4 c. c.
No. 7.	0.45 c. c.
No. 8.	0.5 c. c.

In tubes 1, 2, and 3 there was no precipitate, in tube 4 a very slight precipitate after four days; in tube 5 a precipitate began to form a few hours after adding the soda and increased for several days; tube 6 gave a heavier precipitate than tube 5, tube 7 than tube 6, and tube 8 the heaviest of all.

The presence of a calcium salt also gives rise to a disturbing precipitate so that if it were possible, it would be wise to dispense with the magnesium and the calcium salt altogether. Certainly the latter substance could be very much reduced, as Maassen used only one tenth as much in his solution as Uschinsky did in his.

I have, as time would permit, tried a number of these synthesized media made up with gelatine or agar in the cultivation of water bacteria, and have found some of them very favorable, at least in the number of bacteria which plate cultures would give of a given sample of water. One, which I found very serviceable as far as numbers went, contained the ingredients mentioned above, but in order to avoid as much as possible the formation of a precipitate and the consequent loss of ammonium and phosphates it was prepared as follows: 10 per cent. gelatine was added to the nutritive fluid and boiled; then the exact amount of normal soda necessary to give a pink color with phenolphthalein was determined by titration; this was measured out and set aside, but, before adding it to the jelly, the latter was rendered still more acid by the addition of 1 per cent. lactic acid (9 per cent. solution) then the soda was mixed in. The reason for this procedure was the fact that a precipitate of ammonium magnesium phosphate once formed, it was difficult to get it into solution again. The resulting jelly was acid to phenolphthalein but neutral or slightly alkaline to litmus. A number of experiments with this medium showed, that for Toronto tap water a jelly prepared in this manner and with this reaction gave the best quantitative results. It is likely that the favorable character of this medium, over a more alkaline one, was due partly to the preservation of the ammonium and phosphates, and partly also to the additional carbon nutriment in the form of lactic acid, rather than to the reaction *per se* as we find that for a beef-broth-peptone-jelly, a reaction alkaline to phenolphthalein is necessary for Toronto tap water.

Another culture medium which was tried had the following composition:

Acid ammonium tartrate	0.15
Bi-potassium phosphate	0.25
Potassium sulphate	0.15
Sodium chloride	0.05
Glucose	0.50
Lactose	0.50
Glycerin	1.50
Water	100.00

This was rendered alkaline to phenolphthalein with normal soda. This medium also gave good quantitative results with tap water, so that the presence of the magnesium salt did not seem necessary. In comparison with beef-broth-peptone-gelatine as made up in my laboratory these two media showed about the same quantitative results. On several occasions somewhat larger numbers were obtained with them, than with the latter, but these results were not constant and I had not sufficient opportunity to make a thorough comparison, so as to come to any definite conclusion. I think, on the whole, however, that they would give as good quantitative results as the beef-broth-peptone-jelly. The important point, however, is not so much the quantitative as the qualitative results and here the two jellies above mentioned showed themselves weak. There was a decided

lack of character in the plate cultures which was not pleasant to look at; the jelly was beautifully transparent and colorless, it is true, and the liquefying colonies exceptionally large, but the colonies were without color, and fluorescence where fluorescent forms were present, was slight and late in appearing. The same lack of character was noticeable in stab cultures in gelatine, especially of the liquefying forms. Liquefaction would be extremely rapid, much more rapid than in beef-broth-peptone-gelatine, but there would be an absence of color which made almost all cultures look alike. I do not mean by this, that those producing a decided pigment did not produce it here also, but those slight differences in color which are so marked, yet so incapable of description, were entirely absent. Comparative cultures with various combinations finally led me to the belief that this lack of character was due to the presence of an ammonium salt. The addition of asparagin for instance, to either of the media mentioned above, increased the amount of fluorescence and the suppression of the ammonium salt rendered it still more marked.

I have finally used Maassen's medium combined with gelatine or agar and carbon nourishment given in the form of one per cent. lactose. Comparative plates of this medium with a similar one containing glucose instead of lactose showed the former to be somewhat better in quantitative results.

Maassen's medium is somewhat too alkaline for the cultivation of ordinary water bacteria when used in the fluid condition or in agar, and I have titrated it back with ten per cent. lactic acid until it just gives a pink reaction with phenolphthalein. When made up with gelatine, the gelatine is sufficiently acid to bring it back to the proper reaction for ordinary water forms. Quantitatively it has not given as many colonies as the first two media I have described, but qualitatively it far surpasses them. The bacteria grow in it quite as characteristically as in beef-broth-peptone-gelatine or agar. Asiatic cholera, bacillus coli communis, and a large number of water bacteria grow well in it both in stabs and smears. Typhoid, I have not yet succeeded in growing. Diphtheria did not grow. All these media clear well if well boiled, and filter rapidly. With Maassen's medium made up with one per cent. agar-agar and thoroughly boiled, filtration was possible through a folded filter without hot water, and the resulting jelly was quite clear and transparent.

These are the chief facts which I have been able to learn in regard to the use of synthesized media combined with gelatine or agar in the study of water bacteria, and I regret that owing to the press of routine work which I have had ever since last autumn, I have been compelled to leave many points untouched about which I am still very uncertain. I think, however, that in these synthesized media we have a choice of culture fluids which would answer for all water bacteria and which have this great advantage that they can always be made up with perfect exactness, thereby rendering more certain our descriptions of species and preventing the formation of laboratory varieties.

Before closing I would like to touch upon one or two other newer methods which might advantageously be used in the study of water bacteria.

Beyerinck has described a method of obtaining so-called respiration figures with various motile bacteria which it seems to me might be used with advantage in the study of water forms. This method depends upon the slowness with which oxygen diffuses down through water and the corresponding slowness with which nutritive salts diffuse upwards. A little nutritive gelatine or agar is placed at the bottom of a test tube and then filled up with recently boiled, sterilized, distilled water, or with a one per thousand agar-agar solution, in distilled water. This tube is then infected with the organism to be studied and allowed to stand. In the course of a few days the bacteria grow sufficiently to become visible to the naked eye and they are found to occupy a distinct niveau in the fluid, frequently forming an exceedingly thin one, in the other cases being broader, and in some cases, such as Bacillus coli communis, forming a double niveau, an upper thin one and a lower one more diffuse and broader.

Beyerinck distinguishes three main types of respiration figures, the aerobic type, the spirilla type, and the anaerobic type. These niveaux when developed usually maintain their form for a very long period, and are apparently characteristic for individual species or at least for groups of species. I found Bacillus coli communis to maintain its characteristic growth, as described by Beyerinck, not only in distilled water over gelatine, but in distilled water over a layer of sterilized leaf mold, for from four to six weeks. Recently, I have found a slowly liquefying bacillus from a river water in western Ontario which gave a respiration figure very much like Bacillus coli communis. The relation of oxygen tension in a fluid, is of such marked biological importance for the bacteria therein contained, that it would seem as if a method such as Beyerinck suggests would give us some important results.

The formation of nitrites in culture fluids is an exceedingly interesting biological phenomenon, and one to which I think attention should be paid in the study of water bacteria. Lunkewicz has suggested the use of the Griess-Hosway reaction for nitrites. This reaction, which is practically the same as the cholera red reaction, depends upon the formation of a bright red color when an acid mixture of naphthylamine and sulphanilic acid are mixed with a nitride. It is a reaction which has been used for the identification of nitrites in potable water, and its chief drawback is its extreme delicacy. Distilled water allowed to stand in the air for some time will absorb sufficient nitrites to give a perceptible reaction. As a result of this extreme delicacy, one must be certain, before using it, that the nitrites are not already present in the culture medium, and Lunkewicz notes, in this connection, their almost constant presence in Witte's peptone.

Hosway's formula is as follows:

1. Solution.

Naphthylamine	0.1 grammes.
Distilled water	20.0 c. c.

This is boiled and filtered and then added to 150 c. c. dilute acetic acid.

2. Solution.

Sulphanilic acid	0.5 grammes.
Dilute acetic acid	150.0 c. c.

These solutions are best kept separate and mixed in equal parts before using. About two c. c. of the mixture are required for ten c. c. of culture medium. Lunkewicz recommends it for use in gelatine stabs of cholera vibrios, and other liquefiers, and certainly when used in that way it is very striking, the bright red color showing up strongly against the yellowish gelatine. It occurred to me that it would be well to try it in cultures in fluid synthesized media, and I did so, using Maassen's medium with one per cent. lactose, but not quite so alkaline. I tried it on a culture of Asiatic cholera, and a number of water bacteria, and got a positive reaction in the Asiatic cholera culture after eighteen hours, and in cultures of three water bacteria after two days. In one, a very large non-fluidifying bacillus, forming a flat expansion on the jelly, it was very strong, much brighter than in the cholera culture: in two others, one, a non-liquefying bacillus, the other a fluidifying bacillus belonging to the group of Bacillus borescens, the reaction was about as strong as in the cholera. In six others, one of them Bacillus fluorescens liquefaciens, there was no reaction after two days' growth. It is an interesting question as to the source of the nitrogen which was used in the formation of nitrites, and it is probable that it came from the reduction of nitrites, present as impurities in the chemicals used in the preparation of the culture medium, as some of them were not chemically pure.

The use of nitro-prussiate of soda as a test for kreatinin (Salkowski reaction) has been suggested by Zinno in the differentiation of Bacillus coli communis and the typhoid bacillus. This reaction was given by Bacillus coli, but not by typhoid, and Zinno was able to confirm the presence of kreatinin by Neubauer's method.

Lösener, in a recent paper upon the typhoid bacillus, states that this reaction is not characteristic for kreatinin alone, but also for other compounds, indol, for instance, so that we would not be able to depend on it. He also calls attention to the fact that in the preparation of beef broth, the kreatin may be converted into kreatinin and so produce an error in the results. The same reagent has been recommended by Orlowski as a test for the presence of H_2S in gelatine stab culture. With regard to the production of H_2S, however, Petri and Maassen come to the conclusion that all forms, both pathogenic and saprophytic, produce H_2S if the proper sulphur compounds are present, and care is

taken to have culture medium favorable for the luxuriant growth of the organism to be tested. I cannot speak from personal experience, however, as to the use of nitroprussiate of soda for either purposes.

Marpman has proposed the use of decolorized malachite green or fuchsin in agar jellies for the purpose of testing, as he states, the presence of aldehyde; a culture producing aldehyde, causing a return of color to the medium along the track of the smear. I have tested this reaction in one or two instances, but not thoroughly. The malachite green, which is better than fuchsin, on account of the restraining influence of the latter upon growth, is made up in a one per cent. watery solution, and the color destroyed with concentrated solution of sodium bi-sulphite. I found in the culture of one water form a faint green color in the smear after two days' growth. It is to be doubted, however, whether this reaction is to be ascribed to the presence of aldehydes, or whether it is due to nascent hydrogen. From Petri and Maassen's work upon H_2S production it would seem as if all the reduction phenomena in bacterial cultures were due to nascent hydrogen.

In the study of all these physiological chemical reactions of bacterial cultures the necessity of exact chemical composition is absolute, otherwise it is quite impossible to make comparisons, and it has occurred to me that the only way in which we can make use of any reactions of this nature is by using such synthesized media as I have described, using chemically pure salts and controlling in every way possible the composition of the medium. When that is done we can then speak with definiteness as to the formation of nitrites, ammonia, H_2S, or any of the other substances upon which these reactions depend, but not till then.

ON THE NATURE OF THE FLAGELLA AND THEIR VALUE IN THE SYSTEMATIC CLASSIFICATION OF BACTERIA.

By VERANUS A. MOORE, M. D.,

Bureau of Animal Industry, Department of Agriculture, Washington, D. C.

Since the chairman of the committee requested me to speak on the morphology and specific significance of the flagella, my time has been so fully occupied with more imperative duties that I have been unable to give the subject the attention necessary to include the results of special observations or experiments. It becomes necessary, therefore, to limit my remarks to a discussion of some of the more important results obtained by others and the outcome of certain investigations which I have heretofore made and which in part have already been published. The literature on the subject of the motile appendages of bacteria has become quite voluminous but its reviewer will soon be impressed with the fact that it deals more with methods than morphology, although several apparently important results bearing upon the differential significance of the flagella have been announced.

The fact is well known that much difficulty has been, and still is being, experienced in the demonstration of the flagella. This has retarded the determination of the structural nature of these appendages on the different species to such an extent that it is exceedingly doubtful if our knowledge of the flagella of any of the motile forms is complete. The results of the first positive observations on the number of flagella and their position on the periphery of the individual organisms have been so modified by the results of more recent investigations that there is doubt whether even these two more easily recognized conditions are *established* for any single species. Although the methods of Loeffler (1) with its modifications, Van Ermengem (2), and Bunge (3), are each sufficient to demonstrate the filaments on at least the greater number of motile bacteria, the process is yet to be formulated whereby constant and uniform results can be obtained. It is unfortunate that the methods which have given much satisfaction in the hands of certain investigators have not yielded more constant and uniform results.

It is evident that with imperfect methods of determining the number, position, and structure of the flagella that they can not be considered to any great extent as differential characters. Messea (4), however, as early as 1889 proposed a systematic classification of bacteria based upon the number and position of the flagella of the individual organisms. The classification which he suggested is as follows:

I. Gymnobacteria.

II. Trichobacteria { 1. *Monotricha*. 2. *Amphitricha*. 3. *Lophotricha*. 4. *Peritricha*. }

The *monotricha* have one flagellum at one pole of the bacillus (*bacillus pyocyamus*). The *lophotricha* have a tuft or bunch of flagella at one pole of the bacillus (*bacillus of blue milk*). The *amphitricha* have a flagellum at each pole (*spirillum volutans*). The *peritricha* are provided with rows of flagella (*bacillus typhosus*).

Kruse (5), in a review of Messea's article, says that this classification can have only a secondary value. It is evident that it would conflict seriously with the natural grouping of the *schizomycetes*, as, for example, the *monotricha* would include bacilli, spirilla, and at least one micrococcus (the motile micrococcus described by Ali-Cohen). More recently the observations of Nicolle et Morax (6) and Klein (7) have shown that certain bacteria, such, for example, as the spirillum of Asiatic cholera, could be placed with equal accuracy in the *monotricha*, *lophotricha*, or *amphitricha*. It is apparent from these and other reasons that his classification, while perhaps natural in one sense, is arbitrary and conflicting with other characters quite as important in grouping or classifying bacteria. So far as I am aware, no other system has been proposed in which the motile appendages are considered of first importance as family or ordinal characters.

Fischer (8) in his new classification[1] of bacteria considers the flagella of secondary importance. He divides them according to their position on the organism into two classes, viz., polar and diffuse. In forming his new sub-families and genera he includes the kind of flagella, i. e., whether uni- or multi-polar or diffuse among their characters, but beyond that he does not recognize them to be of differential value. Several articles have appeared, however, in which they are considered of much importance in distinguishing between closely related bacteria, such, for example, as the typhoid and colon bacilli.

THE NATURE OF THE FLAGELLA.

Notwithstanding the somewhat definite results which have been obtained in reference to the structure of the flagella, it appears to be of the highest importance that their nature should be more fully determined before they are accepted as constant and integral parts in the morphology of individual bacteria. The examination of a large number of preparations stained by the same method, and frequently a single specimen, will reveal quite different appearances. In some instances, and in my experience on a large majority of the bacilli, the flagella appear as

[1] Fischer divides all bacteria into two orders (1) *Haplobakterien* (einzelbakterien) and (2) *Trichobakterien* (Fadinbakterien). The Haplobakteriaceï are divided into three families according to the form of the vegetative bodies, *Coccaceen*, *Bacillaceen*, and *Spirillaceen*. The family Bacillaceï is subdivided into four subfamilies, the *Bacilleï*, *Bactrinieï*, *Bactrilleï*, and *Bactridieï*. The first three of these subfamilies contain four genera each, and the last one five, giving a total of seventeen genera for this family. The other families he has not subdivided.

appendages radiating from the body (nucleus according to Bütschli) of the organism. I have occasionally observed, however, a narrow unstained or more feebly-tinted band separating the body of the organism from a deeply-stained ring of which the flagella appeared to be projections. This capsule-like appearance has been illustrated by several observers. (See plates II, III.) Bütschli (9), Zettnow (10), and others, hold that the part of the bacillus which is easily brought out by the ordinary staining methods is the nucleus only, and that the additional portion of the organism demonstrated by Loeffler's method is plasma which surrounds the nucleus. Haeckel (11), on the other hand, states that they have no nuclei. For this and other reasons he refers bacteria to the animal kingdom, placing them in the first class of Archezoa.

Ferrier (12) has recently published a series of interesting experiments in which he shows that flagella on a single species of bacteria,—as determined by the study of several forms,—are subject to variations according to the conditions under which the organism is cultivated. Thus he found that *Bacillus coli communis* cultivated at the temperature of the body possessed several flagelli, but when grown at a much higher temperature (46° C. maximum temperature for this bacillus) flagella could not be detected. If grown at 44° C. a few of the individual bacteria possessed these appendages. The age of the culture and the presence of a non-fatal quantity of an antiseptic in the culture media were likewise found to have appreciable effects. He states that this pleomorphism is due to their protoplasmic nature ; the hypothesis assumed, being that when the bacteria are subjected to degenerative agencies, such as high temperatures or antiseptics, the plasma contracts in a ball-shaped mass (presumably about the organism), but when the bacillus is again brought under favorable conditions the plasma reassumes its motile form.

Accepting this explanation, it is difficult to understand why the non-motile bacteria possessed of capsules such as *Micrococcus lanceolatus* are not, under certain conditions, motile, or why the methods employed satisfactorily in staining the capsule will not act quite as well in bringing out the flagella. I have tried repeatedly to stain the flagella after these methods, more particularly the one used by Professor Welch (13) in staining the capsule on *Micrococcus lanceolatus*, but invariably the results have been negative. Why there should be such a marked difference between the motile and non-motile forms in the reaction of their "capsular" plasma to staining fluids has not been explained.

I have sought for an explanation of the structure of the flagella producing substance in the cilia or flagella of the zoöspores found in certain of the fungi, but thus far my efforts have not been rewarded, although much assistance may be obtained from a study of those forms. It is quite probable that certain observed phenomena, especially in reference to the free flagella and the formation of the rings and hooks frequently observed both on the distal ends of the flagella, and separated from them, may be explained by the same theories as those of the zoö-

spores. There are two views as to the disposition of the flagella of swarm spores. One is, that they are cast off, and the other, that they are absorbed into the body of the spore. Rothert (14) shows, in a recent article, that both views are correct. "In the second swarm stage of saprolegnia and in the peronosporeæ, the flagella are either cast off as soon as the spore comes to rest, or soon after, or else they remain attached to the spore indefinitely even after germination. In the first swarm stage of saprolegnia, however, he found, to his surprise, that they are uniformly drawn back into the body of the protoplasm, the withdrawal being slow at first, and then quite rapid. The loops are formed either while the flagella are attached to the spores, or after they are cast off." He suggests the possibility that the flagella are formed out of special cytoplasm existing only in small quantities. It is highly probable from certain opinions and results herein cited, that there is a close resemblance between the flagella of bacteria and those of the swarm spores.

The observations of Stoecklin (15) and Bunge (3) that several bacilli are sometimes included within the same capsule from the periphery of which flagella radiate (plate II., figures 9 and 10,) is exceedingly interesting. This phenomenon is explained in two ways, one that the surrounding plasma of two or more bacilli runs together, thus enclosing the bacilli in a common capsule, and the other is that the variable number of bacilli included within the same capsule is due to the multiplication of the organism within the capsule. (Plate II., figure 10.) These observations strengthen the hypothesis that bacteria have nuclei and surrounding plasma.

THE FLAGELLA AS SPECIFIC CHARACTERS.

It was my expectation, at the time Loeffler's second method appeared, that the flagella would be of special interest in differentiating species. To that end, I have given considerable attention to the study of the flagella of certain closely related forms, such as the hog-cholera and colon bacteria; *Bacillus typhosus* and *Bacillus cloacae* have also received considerable attention. A somewhat detailed description of certain of these observations was published in 1893 (20), and subsequent investigations on both the same and other species have confirmed the results then recorded. In these examinations, the only differences detected in the flagella of the hog-cholera and colon bacteria were in the maximum number on an individual organism, and in their average length. These, however, were very slight, and necessarily have only a relative importance, as it is not known that by a longer series of comparative observations, these differences in the final averages would disappear. In this work I have examined the flagella, not only on the more typical forms, but also on all of the known varieties of the bacillus of hog-cholera and a considerable number of colon bacteria, isolated from the contents of the intestinal tract, and from the various organs of animals which had died from different causes.

While there were appreciable, and, in some instances, marked, differences in the virulence or cultural characters of the varieties studied, I was unable to find an accompanying variation in their flagella.

In 1891 I (21) isolated from the organs of a pig a nonmotile bacillus which proved to be similar in its pathogenesis and cultural characters to the bacillus of hog cholera, but morphologically it possessed, so far as I could determine, no flagella. In 1894 Dr. Theobald Smith (16) placed this organism in the hog-cholera group on account of its pathogenesis and biological characters notwithstanding its nonmotility. This somewhat striking instance is cited to show that in the grouping of pathogenic organisms the flagella have little or no significance.

The differentiation of *Bacillus typhosus* and *Bacillus coli communis* by means of their flagella has been attempted with conflicting results. Thus, Tavel (17) separated the two species by the absence of the flagella on the colon bacteria and their presence on the typhoid bacillus. Luksch (18) found from 1 to 3 flagella on the colon and from 8 to 12 on the typhoid organisms. He experienced much difficulty in staining the flagella on the colon bacillus. These results are practically confirmed by Fremlin (19). Nicolle and Morax (6), found from 6 to 10 flagella on the colon bacillus and from 10 to 12 on the typhoid bacillus.

In a comparative study of these two organisms I found the maximum number of flagella on the colon bacillus to be 7, and on the typhoid bacillus to be 10. More recently Bunge (3) has found as high as 20 flagella on the colon bacillus and but 13 on the typhoid organism. He does not believe, however, that these two species of bacteria can be differentiated by their motile appendages.

I found there are certain slight differences in the flagella of these two species. In preparations of the typhoid bacillus I usually found a greater or less number of rings and peculiar shaped hooks at the distal ends of the appendages and also many incurved filaments. These, however, occasionally appeared in preparations of the other organisms (see Plates). The average length of the flagella of the typhoid bacilli was about 2 μ shorter than those of the colon bacteria. The fact that frequently the flagella of the typhoid bacilli were longer on the bacteria in certain preparations or fields than they were in certain fields in preparations of the colon bacteria, renders this difference appreciable only after the examination of many preparations, and, perhaps, if the number of observations was increased this difference would vanish.

In studying the flagella on bacillus cloacae I (22) used cultures obtained from four different sources. The general cultural, physiological, and morphological differences manifested by the bacteria in the different cultures were very slight, yet I found a pronounced difference in the maximum number of flagella on the individual organism. Thus of the four cultures examined seven flagella were positively counted on a single organism from two of them, five was the maximum number discovered on an individual from the third, and fourteen from the fourth. Curiously

enough the two cultures on which the maximum number was seven were originally obtained from surface soil and well water respectively and they had been subjected to artificial cultivation for about the same length of time. The other two were originally obtained from a disease of corn stalks. The one containing bacteria possessed of fourteen flagella having been under cultivation for at least three years and the one containing bacteria possessed of five flagella for a few months only. Whether the difference in the maximum number of the filaments demonstrated on the individuals from the different cultures was due to long and shorter periods of cultivation, defects in the staining process, or to an actual difference I am unable to say. It is obvious, however, that the results obtained show a greater difference in the actual number of flagella on the individual bacteria from different cultures of this organism than were found to exist between the hog-cholera, typhoid, and colon bacilli.

In my work upon this subject, and so far as stated or illustrated by others my experience has not been exceptional, there are usually present in preparations for demonstrating the motile appendages a greater or less number of bacteria on which flagella can not be detected, and likewise a variable number of free or detached filaments. These are of variable length and appear singly or in clumps. The length of the flagella attached to the bacteria frequently varies to a marked degree on the same individual indicating an original inequality or a subsequent partial destruction. A review of the more important results relative to the specific value of flagella on at least a majority of the species thus far studied, is that they vary both in the maximum number on an individual and in the maximum length. There is also a marked variation in the number of detached filaments and bacteria denuded of their motile appendages. Furthermore it is found that the differences manifested in the flagella of the same species in different preparations are quite as marked as those found to exist in preparations of different species. Thus the flagella of the hog-cholera bacillus differ in different preparations, and often in different fields of the same preparation, quite as much as they do from the flagella in preparations of the typhoid or colon bacilli.

Another point of peculiar interest is that certain of the flagella appear as projections from the periphery of a capsule while others radiate from the deeply stained central portion. I have frequently observed bacilli surrounded with what appeared to be feebly stained capsules from the periphery of which the more deeply stained flagella seemed to radiate. Incurved and looped filaments, rings, detached straight, loose and closely waved filaments, clumps of flagella radiating apparently from the same point, and bundles of filaments are all encountered, often in the same preparation. In my experience these anomalous forms have been more frequently observed in preparations of *Bacillus typhosus* than in those of any of the other species. In the accompanying plates I have illustrated certain of these variations.

A summary of the more important papers bearing upon the number and

length of the flagella on certain species is given in tabulated form from which the striking difference existing between their recorded descriptions can be easily understood. It is an interesting, if not important, fact, that gymnobacteria, bacteria with unipolar, bipolar, and diffuse flagella frequently and, in my experience, usually appear in one and the same preparation.

Number and length of the flagella as recorded by different writers on three species of bacteria.

Bacteria.	Author.	Maximum number of flagella.	Average number.	Longest flagellum.	Usual length.	Special characters.
Bacillus typhosus.	Tavel.	Several.				
	Luksch.	12				
	Nicolle et Morax.	12				
	Moore.	9	3	13μ	$3-7\mu$	Many incurved filaments and terminal and free rings and hooks. Many free flagella and bacteria without filaments.
Bacillus coli communis.	Bunge.	13	6.5			Many free filaments.
	Tavel.	0				
	Luksch.	3				
	Nicolle et Morax.	10				
	Moore.	7	2.2	15μ		Extended, wavy; few terminal rings, many free flagella and bacteria without filaments.
Bacillus choleræ suis.	Bunge.	20	4.6			
	Moore.	9	3.2	18μ	7μ	Extended, wavy; few terminal rings and many free flagella and bacteria without filaments.
	Ferrier.	7		55μ	$30-50\mu$	

In order to illustrate still further the differences existing in different preparations of the same species, I have appended in tabulated form the dilated results of the examination of two hundred individual organisms in preparations from two varieties of each of the three species.

A comparison of the number of flagella on the individual bacilli.

Bacillus.	Culture.	The number of Flagella. 0	1	2	3	4	5	6	7	8	9	10	Total number of bacteria.	Average number of flagella on each germ.
Choleræ suis......	(1)	12	23	30	47	39	22	12	8	5	2		200	3.3
"	(2)	10	33	33	45	38	19	6	8	6	2		200	3.1
Coli communis....	(1)	9	33	58	44	34	15	4	3				200	2.6
"	(2)	21	83	55	29	13	6	3	?				200	1.8
Typhi abdominalis	(1)	14	23	39	45	27	15	23	11	3	?		200	3.5
"	(2)	17	43	42	45	24	18	5	3	1	1	1	200	2.6

A comparison of the length, diameter and character of the flagella.

Bacillus.	Culture.	Length of longest flagellum.	Length of 70 per cent. or more of the flagella.	Usual diameter of flagella.	Appearance of flagella.
Choleræ suis......	(1)	18μ	7–12μ	0.1 – 0.2 μ	Usually extended, wavy, few terminal rings.
"	(2)	11μ	6 – 8μ	0.1 – 0.2 μ	" " "
Coli communis....	(1)	12μ	5 – 7μ	0.1 – 0.2 μ	" " "
"	(2)	15μ	5 – 9μ	0.1 – 0.2 μ	" " "
Typhi abdominalis	(1)	11μ	3 – 6μ	0.1 – 0.2 μ	Many incurved, wavy, large number of terminal rings.
"	(2)	13μ	3 – 7μ	0.1 – 0.2 μ	" " "

In comparing the figures in the tables the fact should be kept clearly in mind that they have only a relative significance. The large number of preparations examined and the number of counts and measurements made give them, however, a good representative value.

In view of the fact that in the study of the flagella different results have been obtained when the same or different methods have been used, it is very difficult to formulate a general scheme for utilizing the acquired knowledge of these filaments in describing species. It seems to the

writer that, until more satisfactory methods for their demonstration are devised and the degree of constancy in their appearance as morphological elements is determined, the best plan to follow is to record the number, length, and thickness of the flagella on the individual organism together with any anomalous appearance observed. If they are found, as suggested by Ferrier, to be influenced by conditions of environment it is exceedingly doubtful if they can ever be regarded of specific differential importance.

The question very naturally arises in this connection, what is the best method, or, which method should be adopted in demonstrating the flagella? In reply to such an inquiry I would say that according to my experience a method which can be singled out as superior to all others appears not to have yet been formulated. I have obtained the best and most uniform results with Leoffler's method modified slightly in its application. The more recently devised processes, especially those of Van Ermengem and Bunge, I have not thoroughly tested. As the same method frequently gives different results, it remains with the individual to adopt the process by which he can succeed best, until an efficient method is formulated whereby uniform results can be obtained. When that time arrives, the question as to which method shall be used will answer itself.

CONCLUSIONS.

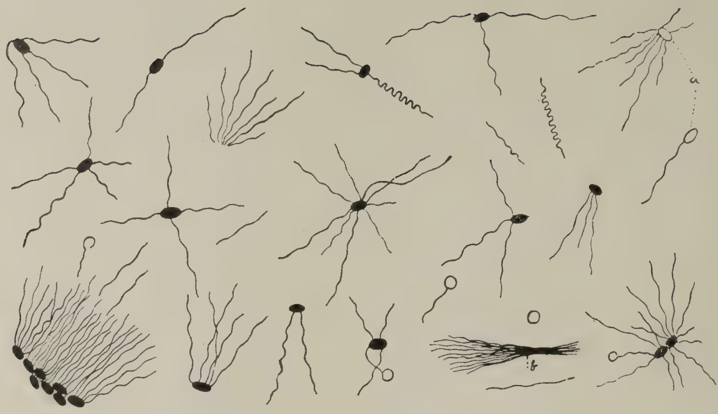
In the foregoing discussion many points of interest, and perhaps of unrecognized importance, have been omitted. The demonstrated facts concerning the nature and character of the flagella are very few compared with those still under controversy or as yet wholly intangible. The observations cited in the preceding pages indicate that much progress has been made in the study of these filaments, although the facts elicited, bearing directly upon the nature and specific significance, are by no means numerous. The various and somewhat conflicting results may be interpreted differently by those familiar with the facts, but so far as I am able to understand the subject, the existing knowledge of the flagella of motile bacteria and their use as diagnostic characters can be summarized in a few somewhat general statements.

1. The methods for demonstrating the flagella are not developed to that state of perfection where the same results are ordinarily obtained by different workers in studying the flagella on bacteria from cultures of the same species. There are, however, several methods by which very good results have been obtained, and by which it is highly probable the flagella on all of the motile bacteria can be demonstrated more or less perfectly.

2. The nature of the flagella or flagella producing substance has not been positively determined. The results recorded indicate that they are composed of a plasma which surrounds the organism, and which under certain conditions differentiates itself wholly or in part into these long or

Plate I

1



2

3

V. L. Moore del.

shortened filaments. Whether this capsular substance splits up into the clearly defined flagella, or whether the filaments are produced by a gradual growth or by a process resembling that in the production of pseudopodia has not been determined. It is highly probable that the flagella are structureless and composed of different substance, as indicated by its reaction in staining reagents, than that part of the organism detected by the ordinary stains.

3. The flagella of closely related bacteria such as *Bacillus cholera suis*, *B. coli communis, and B. typhosus* resemble each other so closely that they can not be considered as specific characters. There are, however, marked variations observed in certain preparations, but these differences are as great between different preparations of the same species as between those of different species, excepting, perhaps, the maximum number of filaments on an individual and their average length.

4. Bacteria possessed of diffuse flagella (Fischer) or the *Peritricha* (Messea) show ordinarily in stained preparations free flagella and individual organisms denuded of their filaments (Gymnobacteria) and those possessed of from one to the maximum number of flagella.

5. The spirilla appear to be possessed of polar flagella only. The larger number of motile bacilli are provided with diffuse flagella.

6. There appears to be little or no assistance in differentiating closely related bacteria to be derived from the present knowledge of their flagella. In separating bacteria into different genera they may, as suggested by Fischer, be of recognized importance.

7. Until the nature of the flagella producing substance is better understood, the only significance which can be given to these appendages in classifying bacteria is to determine their number on the individual organisms, their length, general appearance, and peculiarities, and include such data in the description of the morphology of the respective bacilli. By this method Messea's and Fischer's positions in giving to them family and generic characters can be verified or refuted as the case may be.

DESCRIPTION OF PLATES.

Plate I.

This plate illustrates the similarity in the flagella, as ordinarily observed, of *Bac. cholerae suis*, *Bac. coli. communis*, and *Bac. typhosus*.

The drawings were made by the aid of a Zeiss apochromatic objective, 2 mm., I. 30 n. a. and the measurements were made with the compensating micrometer ocular number 6. Each germ and its flagella were carefully measured and in the drawings each micromillimeter is represented by a millimeter, thus giving a magnification of a thousand diameters. The curves in the flagella were carefully counted and reproduced as accurately as it was possible by freehand drawing. The position of the flagella was also carefully determined. In the preparation of the plate care has been taken to avoid extremes. Individual bacteria

have been selected from different fields to represent the various number, lengths, and position of the filaments on the body of the germs as they appeared in the preparations. A few free, or detached flagella are also indicated. The drawing of each germ is practically equivalent to a photograph. It is possible to find all of the structures represented in a few fields of the microscope in a well executed preparation. The germ in the centre of each figure represents the maximum number of flagella on a single individual. In the left lower corner of each is a drawing of a clump of bacteria with their flagella. There are a few drawings of bacteria (a) with only their periphery and flagella stained.

Fig. 1. *Bacillus cholerae suis.* Drawings made from preparations of the culture of hog cholera bacteria obtained in the state of Illinois. (b) A bunch or strand of flagella.

Fig. 2. *Bacillus coli communis.* Drawings made from preparations from the culture obtained from the human intestine.

Fig. 3. *Bacillus typhosus.* Drawings made from preparations of the typhoid bacillus from a culture which was obtained from the Johns Hopkins Hospital. The upper right hand corner, enclosed in dotted lines, represents all of the bacteria and flagella from a single microscopic field. (From the Wilder Quarter-Century Book, 1893.)

Plate II.

Fig. 1. *Bacillus coli communis.* Showing flagella Bacillus from human feces. (After Bunge.)

Fig. 2. *Bacillus coli communis.* Showing the capsule surrounding the bacilli. Cultures obtained from an ovarian abscess. (After Bunge.)

Fig. 3. *Bacillus Typhosus.* Showing flagella. (After Bunge.)

Fig. 4. *Bacillus Typhosus.* (After Fischer.)

Fig. 5. *Bacillus Typhosus.* (After Fischer.)

Fig. 6. *Bacillus typhosus.* A drawing from a preparation from an agar culture 24 hours old. *A* and *b* show a feebly stained band about the bacilli with incurved flagella and rings.

Fig. 7. *Bactridium typhoideum.* Typhus-like bacilli of water. Shows incurved and extended flagella and rings. (After Fischer).

Fig. 8. Involution forms of Bacteroiden-like bacilli. (After Fischer).

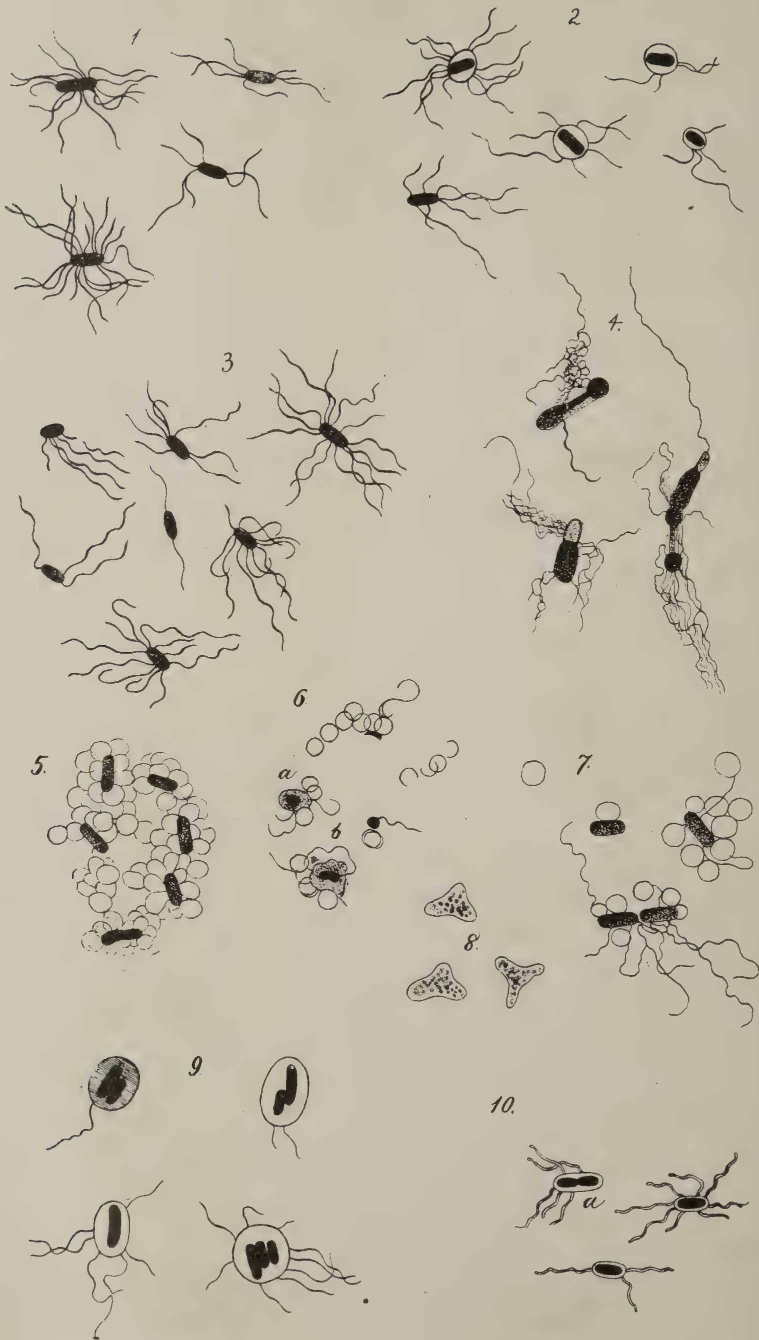
Fig. 9. *Bacillus mucosus.* Showing flagella radiating from periphery of capsule. The capsules containing different numbers of bacilli. (After Bunge).

Fig 10. *Proteus mirabilis.* Showing flagella radiating from the capsule, *a* bacillus undergoing division within the capsule. (After Bunge).

Plate III.

Fig. 1. *Bacillus cloacae.* Showing the maximum number of flagella on an individual bacillus. This figure represents all of the bacteria and flagella observed in a single field.

Plate II



Haines del.

Plate III

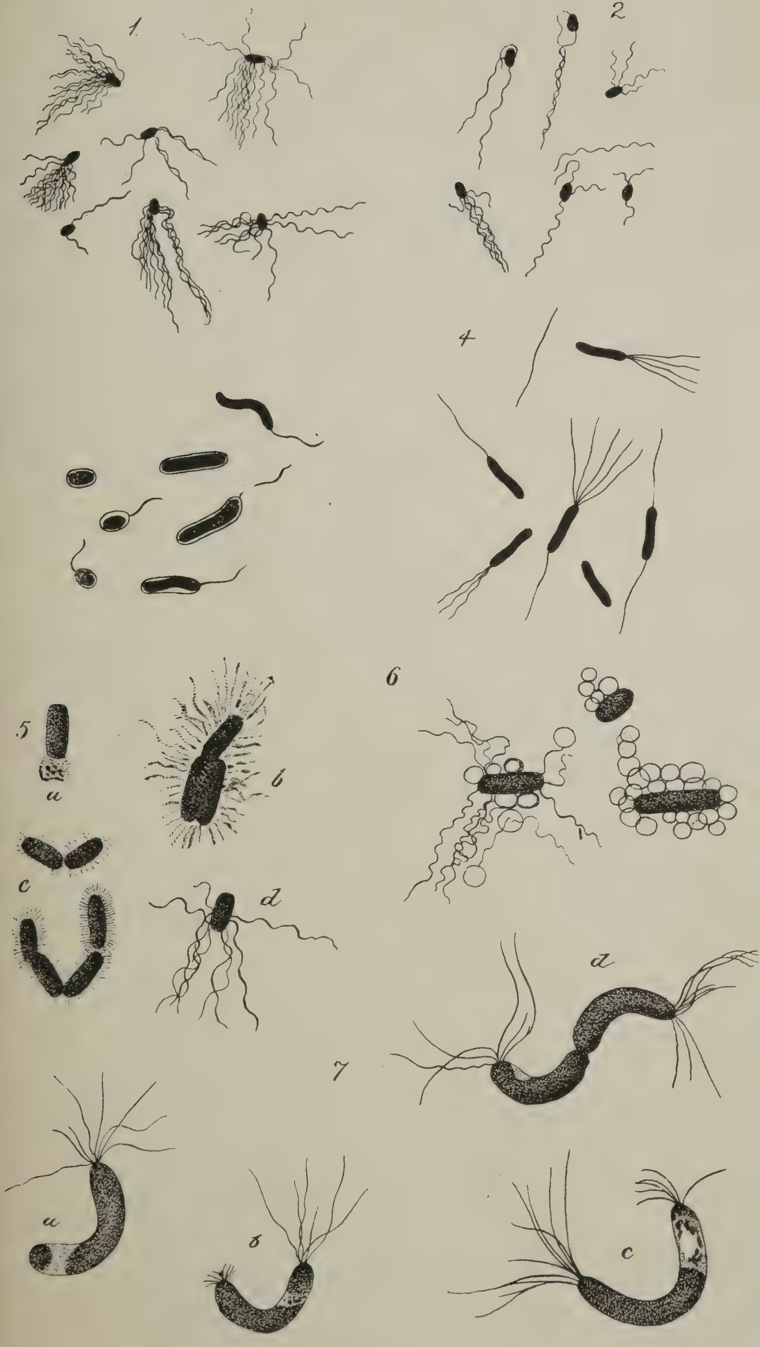


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Fig. 2. *Bacillus cloacae.* From a different preparation showing maximum length of flagella. These figures were made in the same manner as those in Plate I.

Fig. 3. Spirillum of Asiatic cholera with capsule and flagella. The organisms are much swollen from the effect of reagents. (After Bunge).

Fig. 4. Spirillum of Asiatic cholera showing positions and number of flagella as indicated by Nicolle et Morax and Klein. Drawing diagramatic after descriptions.

Fig. 5. *Bacillus subtilis.* Showing development of flagella. *a* Bacillus shows a feebly stained sack-like projection from one end, no flagella. *b.* A group of these bacilli from the same preparation showing flagella. *c* Bacilli from another culture 22 hours old. *d* Bacillus from culture 22 hours old showing fully developed flagella. (After Fischer).

Fig. 6. *Bacillus Subtilis.* Showing extended and incurved flagella and rings. (After Fischer).

Fig. 7. *Spirillum undula.* *a* Typical spirillum with flagella at one pole only. *b*, *c*, and *d* Successive stages in the development of the flagella on the opposite pole. (After Fischer).

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ON GROUPING WATER BACTERIA.

By WYATT JOHNSTON, M. D.,

Montreal, Bacteriologist to the Quebec Provincial Board of Health.

Question No. 7 of the list proposed for discussion: "What tests shall be used in order to separate bacteria into clearly marked groups?" being understood to refer specially to the grouping and classification of water bacteria, the following remarks refer specially to them.

At first sight, it might be thought simpler to determine approximately to which group of organisms a species is most nearly related, than to separate it sufficiently from the known species to justify its description as a new form, but to a great extent the reverse is the case. We find much written about the new species and the special points in which they differ from those already known, but little about the degree of resemblance between existing species, and the extent which the new forms resemble these already recorded.

In order to learn to what extent the tests for species differentiation have been made use of in existing descriptions I have analyzed the most complete descriptions I could obtain in the case of 235 bacteria described as occurring in water. The majority of these were taken direct from the original monograph or article in which the species were first described. When this was impossible, the systematic descriptions of Frankland, Sternberg, and Lustig (2d ed.) were utilized. I have omitted ten forms, the typhoid and colon bacilli, B. nurisepticus, B. cuniculicida, B. anthracis, B. œdema-maligni, B. Tetani, as well as Koch's and Finkler's Vibrios and Staphyloccoccus pyogenes from my list, as not belonging to the water bacteria proper although they have been detected in water.

The relative frequency with which the tests have been made use of is shown in the following table.

Analysis of tests employed in publishing descriptions of 235 *species of bacteria found in water:*

Tests employed.	Times mentioned.	Per cent.	Remarks.
Size,	205	87.2	Vague statement or comparison.
"	144	61.2	Actual measurement given.
Motion,	168	87.9 (of 196)	Forty-four cocci not reckoned.
Flagella,	18	9.4 (196)	Forty-four cocci not reckoned.
Spores,	149	78.0 (of 196)	Forty-four cocci not reckoned.
Staining,	89	37.8	
Gram's method,	75	31.9	Stated if successful or not.

Nutrient gelatin,	210	89.3	Plate or tube.
"	176	74.9	Both plate and tube.
Agar tube,	187	75.3	Agar plate in two cases.
Potato,	193	82.1	
Serum,	15	6.3	
Bouillon,	115	48.9	
Milk,	26	11.1	
Gelatin liquefaction,	215	91.4	Occurrence or otherwise noted.
Relation to oxygen,	213	90.6	
Temperature,	187	79.5	General statement about optimun.
Death point,	5	2.1	
Gas production,	14	5.9	
Relation to acid alkali,	25	106	Production or influence on growth.
Indol formation,	11	4.6	
Reduction of nitrate,	16	6.8	
Pigment formation,	138	54.4	Occurrence or otherwise noted.
"	8	5.8 (of 138)	Solubility, etc., of pigment stated.
Pathogenesis,	26	11.1	
Other media and tests,[1]	52	22.1	
Total average,		46.7	

Tests used in over 75 per cent.—Temperature, relation to oxygen, gelatine culture, agar culture, potato culture, spore formation, motility.

Tests used in over 50 per cent.—Measurement, bouillon, pigment, formation.

Tests used in over 25 per cent.—Staining.

Tests used in over 10 per. cent.—Existence of flagella, milk, relation to acid, alkali, indol formation, pathogenesis.

Tests used in under 10 per cent.—Gas production, death point, nature of pigment, reduction of nitrates, serum culture.

It seems as if the tests used most frequently are chosen more because they happen to form part of laboratory routine than on account of their special value for species differentiation and grouping. There is a noticeable

[1] NOTE. Comprising one or several of the following tests:
Growth on glycerin agar, Wurz agar, acidified and alkalinized potato, distilled water, sea water peptone solution, pancreas broth, Uschinsky solution, bouillons and gelatines containing two to five per cent. sodium chloride, sea-water gelatine, acid gelatine, phenol gelatine, potato gelatine, wort gelatine, Uffelmann's gelatine, Parietti's solution, phenol bouillon, corallin bouillon, Noegerrath tests, litmus gelatine, litmus milk, sterilized fish, boiled eggs. Fermentation of starch, sugar, cellulose, or sulphates. Formation of alcohol, butyric acid. Production of characteristic odors or tastes.

tendency to neglect tests which give definite information positive or negative upon some apparently minor point in favor of those giving information which is either indefinite or difficult to communicate upon points of greater apparent importance.

In the case of the so-called colon group, we find the positive characters to be very indefinite. A certain general agreement as to size and form; a mode of growth in gelatin striking but not in itself highly characteristic; conflicting statements as to motion and morphological character. On the other hand, the results in the tests by Gram's method, gas production, and growth on potato whether positive or negative give important and very definite information.

We find many omissions as to exact measurement of size, determination of death point, presence or absence of gas production, behavior with regard to acid and alkali and the reduction of nitrates. In an astonishingly large number of species, it is not stated whether Gram's method is successful or not. The growth on serum is only mentioned in 6 per cent. of the description of species, yet this would be a very valuable differential test as many of the water-bacteria do not grow on it at all, while some produce a well-marked liquefaction. On the other hand, very elaborate and detailed accounts are given of certain phenomena, such as the appearance of gelatin plate colonies, though it is extremely difficult by reading these to form any idea of what the original object looks like, and quite impossible to remember the long description. In certain tests very commonly used, such as growth on agar, potato, and bouillon, or the appearance of plate colonies under the microscope, there is so great a sameness in the description that—as Virchow said of the old-fashioned medico-legal reports—after reading a number of them one might imagine they all referred to the same case. A good deal of time and labor would be saved if definite types of growth could be described and referred to as such. Points of similarity useless for differentiation might be valuable for grouping.

In the case of pigment formation, which occurs in nearly one half of the water bacteria, it will be seen that the solubility and chemical reactions of the pigment were only ascertained in very few instances. Many of the soluble pigments have well-marked absorption spectra, yet this does not seem to have been utilized as a means of differentiation.

The insoluble pigments present greater difficulties, but it would be more satisfactory to have some better mode of describing them than simply as "lemon yellow," "chrome yellow," "ochre yellow," "sulphur yellow," "orange," "saffron," etc. It would be more in keeping with colorimetry methods to have standard pigments of definite coloring powers, so that the percentage volume of each required to reproduce a given tint could be recorded, and a corresponding tint could be reproduced at will by another observer.

That pathogenesis was only tested in 11 per cent. of the forms described speaks for itself. Of "other media and tests" recorded in the table, as

only in about one fifth of the species' descriptions was mention made of any one of them, they can scarcely be utilized at present for the grouping of species.

The diversity of the tests at our disposal makes it advisable that some general understanding should exist as to what tests should be obligatory and which ones optional in species' descriptions. To ensure general adoption, simple tests, easily carried out, are preferable. The most important requirement, however, in selecting tests is that they shall convey definite information in a form which can be understood readily by others, and which can be recorded in a concise and convenient manner.

In attempting to group bacterial species in a natural manner, the question arises whether a single common characteristic of a nature to readily attract attention, or a number of the minor points of resemblance, should define the group. It appears on the whole preferable whenever possible to choose some single well-marked characteristic rather than several different ones, but at the same time, it is necessary in each case to keep track of all the minor characteristics in order to prevent dissimilar species from being included in the same group. Constant morphological characters should of course be considered of more importance than physiological ones.

It has occurred to me that all the important characteristics of a given species might be recorded more compactly than at present, if a system were adopted by which the information furnished by the various tests could be represented by means of numbers, each stated in a definite order, so as to form a code. In this the type of growth on different media, staining, fermentation, etc., would be recorded in a very condensed form, capable of being taken in at a glance, or so, and that the comparison of any one species' description with any other would be a rapid and easy instead of a troublesome and tedious affair. This would differ from the existing keys in that every leading characteristic would be given in the case of every species, and thus form a sort of cross index to the species when grouped in a natural manner.

The introduction of such a system would involve an arbitrary classification of the existing species' descriptions into definite types—perhaps too bold a step to be taken by an individual—and would be open to the objection of introducing stereotyped formulae into a study that is already too well provided with such.

In considering the question of a natural classification, one is struck with the extent to which the property of liquefying gelatin has been allowed to separate species otherwise closely related. The importance attached to this test has probably hindered as much as it has helped attempts at a natural classification.

Our present position with regard to the grouping of the species of water bacteria may be summed up as follows:

1. The descriptions at present recorded in connection with species of water bacteria do not readily lend themselves for purposes of grouping.

They lay stress on points of difference to the neglect of points of resemblance.

2. Too much importance is attached to descriptions of conditions which cannot be readily utilized by others and too little attention paid to tests by which definite information (yes or no) is obtained.

3. There is a great want of uniformity as to the essential points to be recorded in describing a species. It is highly important that a more uniform plan should be followed in describing species if they are to be grouped correctly.

4. For grouping purposes a single, strongly marked characteristic peculiar to a few species is of more value than a number of minor details, but the members of any group should not differ unduly, in regard to minor points. The liquefaction of gelatin should not be regarded as of sufficient importance in itself to separate into different groups species which are otherwise closely related.

ON THE INFLUENCE OF VARIATIONS IN THE COMPOSITION OF NUTRIENT GELATIN UPON THE DEVELOPMENT OF WATER BACTERIA.[1]

By W. T. SEDGWICK, Ph. D.,

Biologist of the State Board of Health of Massachusetts,

and S. C. PRESCOTT, S. B.

It is well known that the results of bacteria water-analyses often vary considerably, not only when the same water is examined in different laboratories by different analysts, but also in the same laboratory under the same analyst when different lots of culture-media are used. It is not unusual to obtain results more or less discordant from different lots of nutrient gelatin made in the same laboratory, and it is easy to obtain discordant results from the same water planted at the same time upon gelatin obtained from different laboratories, as we have proved by actual experiment. This is true whether surface waters or ground waters are under examination. We cite a few examples:

	Gelatin No.	Colonies per c. c.
A.		
Ground water	1	92, 89
	2	105, 117
	3	228
B.		
Surface water	1	162
	2	116, 112
	3	262, 264
C.		
Ground water	1	221
	2	155
	3	242
D.		
Surface water	4	84, 108
	5	125
	6	171, 184
	3	185, 167
E.		
Surface water	4	165, 188
	5	220, 207
	6	279, 320
	3	308, 316
F.		
Surface water	4	2,250, 2,275
	5	2,300, 2,530
	6	3,312, 3,096
	3	3,024, 3,024

[1] Abstract of a paper, illustrated by diagrams, from the forthcoming Annual Report of the State Board of Health of Massachusetts for 1894.

In each of these cases (A—F) the same amount of the same water was planted at the same time upon three or more specimens of ordinary nutrient gelatin which had been obtained from as many different laboratories in or near New England. Pains were taken to do everything under parallel conditions as regards procedure in planting, incubating, counting, etc., and the results show conclusively that there must have been intrinsic differences between the several media, sufficient to influence materially the development of the colonies.

Similar results were obtained from different lots of gelatin made in the same (our own) laboratory, as follows:

	Gelatin.	Colonies per c. c.
No. I.		
Ground water	A	147
	B	190
	C	248
No. II.		
Ground water	A	560
	B	854
	C	1,400
No. III.		
Ground water	A	385
	B	560
	C	602
No. IV.		
Ground water	A	135
	B	216
	C	201
No. V.		
Ground water	A	212
	B	332
	C	335
No. VI.		
Ground water	D	87
	E	64
	F	106
	G	116

In the hope of discovering and correcting these serious sources of error we have considered, successively, the several constituents of ordinary nutrient gelatin as constants and variables and, having made the nutrient media in such a manner as to test the efficiency of the several constituents, have, as we believe, been able to determine more or less fully the part played by each and the conditions which, separately or collectively, tend to produce discordant results.

The ordinary nutrient gelatin as made in the biological laboratory of the Massachusetts Institute of Technology is prepared as follows:

One pound of lean beef (the lower part of the "round" is generally used) is chopped fine and covered with one litre of water, then heated on a water-bath for one half hour and immediately afterwards boiled, directly over the flame, for fifteen (15) minutes. The mixture is next filtered (hot) through wet filter paper (which holds back the fats) and a filtrate is obtained which is perfectly clear, acid "meat-juice." The water lost

by evaporation is replaced, and to the meat-juice so prepared are added 10 grams of peptone, 5 grams of salt, and 100 grams of gelatin. The next step is to heat on the water-bath to dissolve the gelatin, "bring to a boil," and titrate while hot. For the titration 1 c. c. is taken, and diluted with about 10 c. c. of distilled water. Twentieth normal sodium hydrate is used in the titration, with phenolphthalein as indicator. Three titrations are made and the average is taken. Sufficient sodium hydrate (normal solution) is added to the medium to bring the whole amount to an acidity of 0. 2 c. c. twentieth normal for each cubic centimeter. The whole is heated to boiling and titrated again. It is next cooled to 40° C and the white of an egg shaken with 50 c. c. water is added, after which the fluid is heated gradually to boiling, being stirred to obtain a complete mixture of the egg with the gelatin. It is next boiled for about five minutes, filtered through flannel, tubed, and sterilized.

In the preparation of the nutrient gelatin according to this method we have obviously several factors to consider, and of these we shall deal with the following:

A. Acidity.
B. Peptone.
C. Meat-juice.
D. Gelatin.
E. Salt.

The critical examination of these factors one by one has been taken up in the following way. Ordinary nutrient gelatin made according to the above formula has been prepared and used as a standard. Gelatins made at the same time, under precisely similar conditions, and with similar material with the exception of a single constituent, have also been prepared for comparison. In one case the gelatin (for example) was regarded as the variable, all the other constituents remaining as constants; in other cases the meat-juice, or the acidity, were treated as variables; and in this way much light was obtained upon the effect of varying the amounts or kinds of the several components. In the case of peptone it was found that the light-colored "peptone" of commerce is more efficient than the dark-colored, and that albumose is probably better than peptone.

(*A.*) Acidity.

The acidity or alkalinity of the nutrient gelatin used in bacteriological work, is a matter of great importance. The directions for preparation of media, given in books on the subject, usually pass over the question of acidity without comment, simply advising the addition of soda until slightly alkaline. It has long since been shown that different indicators give entirely different results in titration of acid and alkali, so that a solution "slightly alkaline" to one indicator, might be decidedly acid when tested with another. Our experiments indicate that the best results are obtained by the use of a medium slightly acid to phenolphthalein. The

best acidity according to our experiments is that requiring 0.2 c. c. of twentieth normal sodium hydrate solution to neutralize 1 c. c. of the gelatin medium, before sterilizing.

It should be remembered that phenolphthalein is easily affected by CO_2 and hence the neutralization of an acid by sodium carbonate should not be undertaken, using phenolphthalein as an indicator. We have found that gelatin which has been brought to an acidity of 0.2 twentieth normal before sterilizing shows a greater acidity after its sterilization has been completed, and that this greater acidity is not always the same, even for the same lot of gelatin. For example, a lot of gelatin was made with the usual precautions in regard to acidity and sterilization, having been brought to an acidity of 0.2 twentieth normal before sterilizing. After sterilization readings were obtained as follows: .43, .31, .365, .40, .41, .365, .45, .375, .21, .34, .265, .31, .315, .31, .24, .31, .34, .21, .225, .325, .25, .40, .45, .45, .45. These results were obtained from different tubes of the same lot, and it becomes an interesting question to consider, not only why the acidity became greater after sterilizing, but also why so much variation existed between equal portions of the same original mass.

In general we find that an acidity of 0.2 twentieth normal per cubic centimeter gives the most numerous colonies. Our results have been plotted on a diagram and afford an interesting illustration of this fact. It appears, however, not only that the kind of peptone used is important, but also that the optimum acidity is less or more according as a light-colored or a dark-colored peptone is employed.

In the preparation of the gelatin, the tubes of which were titrated with the results given above, dark-colored (Merck's) peptone was used. Portions of this gelatin even from a single tube gave results differing slightly among themselves. This may easily be accounted for by the color of the liquid, which is present, even in dilute solution, for the difficulty of accurate titration of a brown liquid is well known.

By working simultaneously with a large number of nutrient gelatins varying from strongly alkaline to strongly acid, it was easy to find the point at which the greatest development of bacteria occurred. This point was found to be an *actual* (tube) acidity of 0.3 c. c. n-20 per cubic centimeter for light-colored (Witte's) peptone and 0.4 c. c. n-20 for dark-colored (Merck's) peptone.

(B.) Peptone.

For purposes of comparison of peptones, as such, another lot of gelatin was made up, using light peptone (Witte's *peptonum siccum*) instead of the dark (Merck's) peptone. The acidity to phenolphthalein was brought to the same point in both cases. In these titrations one cubic centimeter of the gelatin was diluted to about 10 c. c. with distilled water, and titrated while hot, and the results obtained by use of this gelatin have in

every case been higher than those obtained from the dark-peptone gelatin with the same water or other material tested.

Variations in the amount of Peptone. Some experiments were made in which larger amounts of peptone than usual were employed, both 15 and 20 grams to the litre having been tested. The numerical results of growth with these media are here given:

	Colonies per c. c.
No. I.	
10 gr. Peptone-gelatin	101
15 " "	183
20 " "	217
No. II.	
10 gr. Peptone-gelatin	300, 278
15 " "	365, 344
20 " "	374, 373
No. III.	
10 gr. Peptone-gelatin	60
15 " "	66
20 " "	69
No. IV.	
10 gr. Peptone-gelatin	56
15 " "	73
20 " "	64

These experiments would have been carried further, if those described under the next heading had not indicated that something better than peptone might be found.

SOMATOSE-GELATIN.

We are indebted to Prof. R. H. Chittenden of Yale University for the suggestion that, inasmuch as the light-colored (Witte) peptone contains a larger percentage of albumose than the dark-colored (Merck) peptone, it would be desirable to cultivate bacteria upon a medium still richer in albumose; and also for the information that such a substance exists in commerce under the name of "Somatose," prepared by W. H. Schieffelin & Co., of New York. According to analyses made by Prof. Chittenden, and kindly communicated to us, "Somatose" has the following percentage composition:

Water	8.94
Solids	91.06
Ash	6.95
Fatty matter	0.10
Albumoses	70.07
Gelatoses and gelatin-peptone	8.03
Peptone	5.01

The nutrient medium used in our experiments on somatose was made up of one litre of water, ten grams of somatose, one hundred grams

of gelatin, and five grams of salt. Nothing further was added. The mixture was brought to the desired acidity (0.2 twentieth normal per cubic centimeter) by the use of sodium hydrate. The solution of somatose and gelatin is much less turbid than that with peptone and gelatin.

The results obtained by the use of somatose have been very satisfactory and a few may be given here.

	Colonies per c. c.
No. I.	
Ordinary peptone-gelatin	130
Somatose-gelatin	195
No. II.	
Peptone-gelatin	42
Somatose-gelatin	77
No. III.	
Peptone-gelatin	3826
Somatose-gelatin	4540
No. IV.	
Peptone-gelatin	2718
Somatose-gelatin	3266
No. V.	
Peptone-gelatin	125
Somatose-gelatin	123
No. VI.	
Peptone-gelatin	763
Somatose-gelatin	968
No. VII.	
Peptone-gelatin	1365
Somatose-gelatin	1564

These results indicate that the development of water bacteria is greatly increased by the substitution of albumose for peptone, and further experiments have confirmed them. It will be observed that no meat juice was used in making the somatose-gelatin.

C. Meat Juice.

The differences in the meat juices used in the preparation of media appear to be of small importance. We have taken this as the variable in a series of experimental media and find that while there is a slight variation in the results it is in many cases no greater than could be expected when the large working error to be allowed is taken into account. The following are the figures obtained with three samples of water (A, B, C) planted on four gelatins differing in the particular meat juice present but otherwise closely similar.

	Colonies per c. c.
A.	
Gelatin No. 1	108, 130
No. 2	110, 140
No. 3	114, 121
No. 4	138, 139
B.	
Gelatin No. 1	260, 271
No. 2	206, 194
No. 3	256, 251
No. 4	243, 233
C.	
Gelatin No. 1	78, 73
No. 2	91, 75
No. 3	78, 78
No. 4	73, 75

(*D.*) Gelatin.

To determine to what extent the discordant results obtained in bacteriological work are due to the gelatin itself used in preparation of the culture medium is a somewhat difficult undertaking. Owing to the unstable character of gelatin the decomposition products caused by heating may be very different and act in different ways towards growing organisms. Our investigations of gelatin have been confined mainly to two varieties, hide gelatin and bone gelatin, and a comparison of the results obtained by their use with those obtained by use of the ordinary gelatin used in bacteriological laboratories.

Hide gelatin is prepared from the trimmings, loose ends, and small pieces cut from hides to be used for tanning. These pieces are placed a solution of lime for some time, and are kept constantly in motion; lime-water being used because the pure gelatin is more soluble in alkaline solutions than in water. The solution is warmed by means of steam, but an excess of heat is avoided, as certain undesirable extractives are soluble in hot water. When an amount of gelatin sufficient to solidify well has been dissolved, the solution is drawn off and treated with enough sulphurous acid to neutralize the lime and give in addition a slightly acid reaction, thus retarding damage by bacteria before the gelatin can be dried. After the acid treatment the gelatin is run into moulds, cut into thin sheets, and dried.

For bone gelatin the process is similar. The bones are dried and crushed, and then treated with lime and the other reagents as in the case of hide gelatin.

In physical properties the two gelatins vary but slightly. The bone gelatin is darker in color, is less soluble, and therefore remains solid at a higher temperature. It appears to be less readily liquefied by bacterial action, but this point has not been fully proved. On titration of gelatin solutions, hide gelatin is found to possess the greater acidity.

A few results obtained by the use of hide, bone, and ordinary gelatins may be given:

	Colonies per c. c.
No. I.	
Hide gelatin	142
Bone gelatin	148
Ordinary gelatin	130
No. II	
Hide gelatin	1,800
Bone gelatin	1,667
Ordinary gelatin	1,488
No. III.	
Hide gelatin	64
Bone gelatin	48
Ordinary gelatin	42
No. IV.	
Hide gelatin	4,170
Bone gelatin	3,100
Ordinary gelatin	3,826
No. V.	
Hide gelatin	2,975
Bone gelatin	2,960
Ordinary gelatin	2,718
No. VI.	
Hide gelatin	120
Bone gelatin	126
Ordinary gelatin	125
No. VII.	
Hide gelatin	1,064
Bone gelatin	1,092
Ordinary gelatin	763
No. VIII.	
Hide gelatin	469
Bone gelatin	391
Ordinary gelatin	219
No. IX.	
Hide gelatin	1,800
Bone gelatin	1,524
Ordinary gelatin	1,365
No. X.	
Hide gelatin	1,400
Bone gelatin	1,246
Ordinary gelatin	1,205

These results indicate that hide gelatin is, as a rule, more effective than bone gelatin, and that both are superior, for use in bacteriology, to the gelatin ordinarily used.

For much valuable aid, information, and advice in this part of the work we are indebted to Mr. G. R. Underwood.

(E.) Salt.

Several experiments have been made upon nutrient gelatin in which the amount of salt was the variable. Some of the results are the following:

No. I.

	Colonies per c. c.
Gelatin with 5 gr. salt per litre	125
Gelatin without addition of salt	142

No. II.

Gelatin with salt	389
Gelatin without salt	444

No. III.

Gelatin with salt	2,718
Gelatin without salt	3,645

No. IV.

Gelatin with salt	3,920
Gelatin without salt	3,920

No. V.

Gelatin with salt	47
Gelatin without salt	87

No. VI.

Gelatin with salt	763
Gelatin without salt	1,141

No. VII.

Gelatin with salt	101
Gelatin without salt	193

These experiments indicate that the addition of salt to the usual extent is not only unnecessary but even detrimental.

It is fair to conclude that if our results are confirmed it will become possible to simplify considerably the formula for the making of nutrient gelatin and, at the same time, to increase its efficiency. We hope to be able, before very long, to offer to bacteriologists some such formula.

PROCEEDINGS OF THE CONVENTION.

Dr. Charles Smart.—I presume that you are familiar with the circumstances under which this convention was suggested. For many years back the American Public Health Association has had a Special Committee on Pollution of Water Supplies. In the report of this committee at the last meeting of the Association in Montreal it was recommended that a coöperative investigation be instituted with regard to the bacteriology of water supplies. The suggestion was favorably received by the Association, and a committee was appointed to find out whether the idea could be put into successful practice. I was made chairman of the committee with power to increase the membership, the intention being that the Water Committee should eventually consist of all those bacteriologists who were willing to enter into a practical investigation of the subject. The Water Committee was thus at that time merely a skeleton. I was appointed chairman of it, because I had been chairman of the Special Committee for several years. There were at the Montreal meeting a number of bacteriologists who were interested in this matter, and these were immediately added to the committee as members. They held several meetings and a sub-committee was appointed to consider methods and elaborate a scheme of laboratory work that would be acceptable to all those who proposed to engage in the investigation. This sub-committee put itself into communication with many of the laboratories in the United States and Canada, and after a full consideration of the subject its members came to the conclusion that it would be impossible for them to draw up any standard scheme for general use without having the benefit of a consultation with the men who know most about the matter. Thus the idea originated that a convention should be held in this city of New York on June 21st and 22d, the object of the convention being to discuss certain mooted points. Well, the day has come, a goodly percentage of the men have come, and so far as I can see at the present time it remains for me only to ask Professor Welch of Johns Hopkins University to take the chair and proceed with the special work of the convention.

Prof. W. H. Welch.—Dr. Smart has explained the origin of this gathering and its purposes very clearly. It is evident from what he has stated that this meeting is the result of an effort to secure some sort of coöperation in the study of the various problems relating to the differentiation of species of bacteria, and it is evident from the programme that has been prepared that the subjects for our consideration relate almost exclusively to certain technical matters which evidently must be elucidated before any coöperative investigation can be undertaken. How far it may be the sense of this gathering to go outside of these special questions

of a technical nature into other veins, I do not know. I should suggest, however, that for the present at least we should confine ourselves strictly to the questions laid down, and I trust that the discussion on these various subjects will be a very full one. It will be most helpful if all will take part freely in the discussion.

This meeting together for the first time in this country of a convention of bacteriologists is most interesting. It is quite possible that this may be the starting point of similar meetings, or possibly of the formation of an association of bacteriologists hereafter.

I think it best to plunge at once into the subject, and I therefore ask Mr. Fuller to speak on the first subject before us: What method shall be followed in neutralizing media, and what standard degrees of reaction shall be adopted?

Mr. Fuller's paper. (See page 381).

Chairman.—Mr. Fuller's very interesting and important contribution is now before us for discussion.

Dr. J. J. Kinyoun.—I heartily commend Mr. Fuller's paper, in which are brought out a great many valuable points in the methods of water analysis. In my work of preparing the toxines for diphtheria during the last year, I have prepared media from the meat juices by the ordinary method, but it was not satisfactory. In some instances it would give good results, and in others not. I have adopted in the main the points as laid down by Mr. Fuller in this work, by using phenolphthalein as an indicator for alkalinity. Since the adoption of this plan I have had very little difficulty in obtaining standard toxine.

The same plan I find well adapted in standardizing the chlorides. The peptone should also be taken into consideration, because it varies considerably. Witte I think should be taken as a standard. In some samples of this there is a considerable quantity of phosphates, due to the imperfection in the preparation of peptones, by the use of salts of calcium. Phenolphthalein has given the best results in bouillon—much better than the ordinary method with litmus. I have adopted the plan of neutralizing the beef tea just after it has been boiled and filtered, so that the greater amount of the phosphates will be precipitated; and while keeping it just under the boiling point, adding alkali sufficient to bring out a purplish coloration. That I take as the point of neutrality; and when I wish to make an alkaline bouillon, I add 0.10 per cent. alkali to this bouillon. For water analyses, especially where glucose is added, etc., I find this of great value.

Dr. Theobald Smith.—I think it might be well to mention that in the cultivation of bacteria, especially of those which produce capsules, or have a tendency to produce them, the growth begins immediately in strongly alkaline media. It seems that the effect of alkali upon the capsule, or whatever the substance is, that is around the bacteria, becomes more marked as the growth advances; and toward the end of the cultivation the growth which had been already established, becomes quite viscid.

I think it also should be mentioned that fluid media are less sensitive to reaction than solid ones, and that a person may err one way or the other with fluid media and still obtain a more nearly normal growth with our more ordinary method than in the case of solid media.

I presume that in discussing this question, we are likely to tread upon other questions, which will be discussed later on; but I see no way out of it. Last winter we used some bouillon which was made by the regular laboratory system, but which by accident was made acid. For some time this medium was used for the cultivation of the mouse septicæmia organism. When the culture was transferred to gelatin tubes the organism failed to liquefy the medium. The middle layers grew opaque, but the culture failed entirely to present its characteristic form. But just as soon as the reaction was changed a beautiful growth of well known appearance was readily obtained. I think that this is a very good illustration of the influence of reaction upon the differentiation of species of bacteria.

In a careful consideration of this question of reaction it appears to me that there is one point of first importance, as Mr. Fuller has similarly suggested. I refer to the influence of glucose on the reaction of media, and I think this ought to be brought out in detail in the meeting. It is well known that many anaërobic bacteria in the presence of this compound produce acid, and it takes only a few hours of cultivation to change the nature of the culture medium entirely, so that all the trouble which has been taken is brought to naught. And probably you all know that if the amount of glucose gets up to four per cent. it is likely to kill the culture.

Dr. Smith.—I wish to say that as far back as 1885 I pointed out that an organism, called at the time *bacillus clodius*, and which produced no color in milk, gave, as soon as ammonia or any other alkali was added, a decided color.

Chairman.—I think we are all very grateful to Mr. Fuller for giving us such precise data. We have used phenolphthalein as an indicator in our laboratory, with very good results. We were fully acquainted with the uncertainties resulting from the use of carbonate of sodium for alkalising a medium. We read constantly in the text-books that solutions of agar are neutral, but our experience has been that they are slightly alkaline.

Mr. Fuller states that it is a matter of indifference, so far as the capacity for growth of bacteria is concerned, whether we use carbonate of sodium or caustic soda for alkalising the media. That, of course, is true within ordinary limits; but it is well known that if we wish to obtain any high degree of alkalinity of the media, we can secure that with sodium hydrate better than with sodium carbonate without restraint of bacterial growth.

Of course Mr. Fuller has had in mind all along the bacterial reaction for certain purposes where it is necessary, as he has indicated, to vary the reaction. It is well known that the cholera bacillus will grow in

media which are very alkaline, comparatively speaking. Just the reverse is true of the typhoid bacillus, which grows very well in neutral media, and which will grow in acid media which have not been neutralized at all. There are, under special circumstances, advantages in using neutral, or even slightly acid, media. Of course all that is possibly aside from the immediate subject that Mr. Fuller has brought up.

Mr. Geo. W. Fuller.—I should like to ask, Mr. Chairman, with what indicators your experience with the reaction of agar was obtained.

Chairman.—We used phenolphthlein and both red and blue litmus paper.

The next paper is by Prof. W. T. Sedgwick, on the effects upon species differentiation produced by the ordinary difference in composition of peptone, meat juice, gelatin, etc.

Professor Sedgwick's paper. (See page 450).

Chairman.—Professor Sedgwick's paper is now open to discussion.

Dr. A. C. Abbott.—I have been much interested in Professor Sedgwick's paper which we have just heard, and there is one point on which I would like to ask him a question. It is manifest that the only conclusion at which it is possible to arrive has been reached, but I wish to obtain information as to the accuracy of the method for the quantitative determination of bacteria in water. I have done a fair amount of work in ordinary water analyses, and I have never succeeded in making the number of colonies from duplicate samples agree. From my experience it is manifest that there is a very wide experimental error in the work, and if Professor Sedgwick has any new ideas with regard to the method, I should like very much to hear what they are. To me this line of work has been one of the most unsatisfactory performances that I have ever tried.

Professor Sedgwick.—I have not had quite the unhappy experience that Dr. Abbott has had. I think that the discrepancy in results from duplicate samples, unless the numbers are very high, is only a moderate one. Of course, in the case of the high numbers, the difficulty is great, but I did not intend to bring any such results into this investigation. With regard to the actual results under consideration the discrepancies were quite marked in some instances, but by no means uniformly so, as you will see as I read off some of the numbers made from duplicate plates: 84–108; 171–184; 158–167; 279–320; 220–227; 165–180; 308–316; 2250–2275; 2300–2330; and so on. But the final results, from which the conclusions were drawn, were obtained from a large number of counts, always taking duplicates and averaging them; that is, taking the mean of the two, and then having a large number of those to work from.

Of course it is very difficult to get close counts on plates with large numbers of colonies. Everybody knows that. But at the same time in making such counts repeatedly, one is able to use better judgment in selecting representative portions of the plate from which the total number of colonies is calculated. Whenever it is feasible it is evident that this

discrepancy in the case of high numbers may be lessened to a considerable degree by diluting the original samples of water, thereby obtaining plates on which the number of colonies is moderate.

Dr. Smith.—Mr. Chairman: I would like to raise a question about the special brand of gelatine, inasmuch as we are limited to one. Would it not be well to have the convention determine the matter of a standard brand, and have it definitely settled for all laboratories.

I would say that in my own experience a certain gelatine which I was in the habit of using failed, because it did not solidify at the temperature that another did.

Professor Sedgwick.—I did not understand that the question was to decide what our commercial gelatine was to be. But I think that it is a thing that a convention like this has come together for, beyond doubt.

We went to a man whom we knew; he is an expert chemist in charge of a great glue and gelatine factory, in Danvers, Massachusetts, and knows all about the gelatine business. He gave us these gelatines as samples from his particular mill. As we are in communication with him from time to time, there would be no difficulty in getting them from him.

Dr. Adami.—What is meant by commercial gelatine? Does it refer to the best French brands with which we ordinarily work?

Professor Sedgwick.—Yes.

Mr. J. J. Mackensie.—There is one point which I would like to mention in regard to gelatine used in photographic work. I believe they have three varieties; hard, medium, and soft. The temperature at which gelatine melts, I think is a very important point. But I don't know whether any one of these three varieties melts at a higher point than the others.

Chairman.—It would be useful if we could be placed in possession of some standard quality of gelatine.

Then there is another point which I would like to bring up, and that is whether anyone has noted a change in reaction caused by the glassware. My attention has been called to the fact that certain cheap sorts of glass cause a precipitate to form in culture media. I was unfortunate enough to get that sort of glass in Germany. Has this been a common experience?

Dr. Coplin.—I wish to say that my experience has been somewhat similar to that of the Chairman. We have had in our laboratories test tubes which affected the reaction of media contained in them. The quality of the glass was undoubtedly poor. This was most noticeable in tubes which had held cultures for some time. In some instances, as a result of sterilization by hot air, some flakes or scales appeared on the inner surface of the tubes. This seemed to increase the change in reaction, which became more alkaline.

Mr. Fuller.—Three or four years ago we had the same difficulty with thin walled test tubes of German make. Since that time it has been our custom to use thicker walled tubes of high grade of glass, made to order by Whitall, Tatum & Co. By this means our former difficulty has been overcome.

Dr. Abbott.—I have had this experience with cheap glassware. It is our custom to clean new tubes by boiling them in a caustic potash solution, wash in acid solution, and finally rinse with water.

Chairman.—Is there anything more to be said on this subject? If not, we will proceed to Question No. 3: What media shall be used for all species differentiation, and how shall they be uniformly prepared? Discussion on this subject will be opened by Mr. Fuller.

Mr. Fuller.—In opening this discussion it is hardly necessary for me to say that I shall simply call attention to some of the more important points. A thorough discussion of this subject would be practically equivalent to the preparation of a text-book, and would obviously be out of place on this occasion. I shall accordingly select those points on which, it seems to me, an expression of opinion by the men from the various laboratories is most essential.

It may also be added, by way of introduction, that the views which I shall set forth are the result not only of my own experience and reading, but, in certain instances, of careful perusal of the letters received in answer to Circular Letter No. 1, issued by the sub-committee on methods.

PRINCIPAL MATERIALS OF WHICH MEDIA ARE COMPOSED.

This discussion naturally begins with a consideration of the principal materials or ingredients which enter into the composition of culture media. We will first take up the question of water which is the chief constituent of all artificial as well as natural media.

WATER.

Experience seems to vary in the different laboratories with regard to the water used in this line of bacterial work. Some employ distilled water, while many, if not most, bacteriologists make use of tap water.

It is my custom to use for this purpose city (filtered) water, and so far as I have been able to learn it serves equally as well as distilled water. Nevertheless, we have abundant proof to show that the chemical composition of different public water supplies is quite unlike; and, further, that in many instances the composition of the same supply varies at different seasons of the year. As it is our purpose to have standard methods for the preparation of media, I recommend distilled water for use in this connection.

MEAT INFUSIONS.

Under this point we have two things to consider: first, the method of preparation of meat infusions; and second, the decision as to whether we shall use infusions of fresh meat or commercial products known as meat extracts.

Meat infusions are usually prepared by digesting about one part of finely chopped lean meat (beef) in two parts of water. A point which

perhaps is worth mentioning is that in this country we use one pound (455 grams) of meat to one liter of water. In Europe, at least on the continent, it is the practice to use 500 grams of meat to one liter of water. This gives a difference of nearly ten per cent. in the strength of the infusions, and on the grounds of greater accuracy and uniformity, it may be advisable to keep in touch with European practice and use exactly one part of meat to two parts of water.

Custom varies with regard to the manner in which the infusion is obtained. Some allow the solution to digest in the ice chest for about twenty hours, while others heat the solution for half an hour or more. In the laboratory of the Imperial Board of Health at Berlin it is the practice to allow the solution to stand for one hour in the ice chest; heat for three hours at 60°C.; and then boil for half an hour.

During several years at Lawrence we prepared the infusion by heating the solution for half an hour on a water-bath. For the past two years, however, we have allowed it to stand for twenty hours in the ice chest with occasional stirring. I have not made complete chemical analysis of the infusions from the same meat by the several methods, but judging from the results of repeated tests for the intensity of reaction there seems to be practically no difference in the amount of extractives obtained from the same meat.

There are two reasons why I prefer to allow the extraction to take place in the cold. In the first place, meat infusion prepared in this way contains sufficient albumen to effect the clarification of gelatine and agar, without the subsequent addition of eggs. Secondly, this method prevents the presence in the nutrient media of fats which, after the cells are once broken up by heat, are removed with difficulty by filtration, even at a low temperature.

With regard to the relative advantages of meat infusions and of commercial meat extracts, my experience is insufficient to express a definite opinion. I may add, however, that it has been our constant practice to use meat infusions for all regular work, although we always keep in the laboratory a bottle of Liebig's meat extract to use for special purposes in case of emergency.

When listening to Prof. Sedgwick's paper the thought came into my mind: Are meat infusions, which at best are quite variable in their composition, absolutely necessary for our work? At Lawrence in 1891, we made some experiments with fair success with the use of nutrient gelatine which contained no meat extractives. It did not appear advisable at that time to break away from the regular custom, and to-day, unless new evidence is brought out in the discussion, such a step would scarcely be warranted.

Nevertheless, I hope that the day will soon come when this factor of variability may be removed.

PEPTONES.

For some time it has been known that there is a marked variation in the composition of commercial peptones. With the view of overcoming this in part, it has been my custom to procure our supply in relatively large quantities, in five-pound bottles. Portions are removed for convenience into smaller bottles for current use. Until this year we used Witte's peptone, at present our supply is from Merck.

The influence of composition of peptones upon bacterial cultivation has been clearly set forth in Prof. Sedgwick's paper. The results of his investigation showed that of the peptones with which he worked, the one made by Witte was superior to that made by Merck. This also appears to be the experience of some other bacteriologists.

With regard to the different brands of peptones which we have at the Lawrence laboratory I have an interesting experience to relate. I have not given this question so much attention as Professor Sedgwick has done, but during the past few weeks I have obtained some comparative results. They came about in this way: I was studying the question of indol-production by bacteria, and none of the samples of peptone which we had in the laboratory at the time gave satisfactory results owing to the amount of indol originally present in the peptones. This led to the use for this purpose of Sargent's peptone, a brand which has been used with satisfactory results by Professor Jordan of the University of Chicago.

Sargent's peptone differs in appearance from the ordinary brands in that it is not a powder, but has a granular form. This appearance is characteristic of albumose rather than of peptone. The color is quite light. It was found to be readily soluble in water, a characteristic not possessed by any other peptones with which we have worked at Lawrence.

It was wholly unnecessary to add sodium chloride to aid it in dissolving, as custom and experience tell us is necessary with ordinary peptones. With its use the indol test was very satisfactory, as I will mention farther on.

After this evidence was obtained, the samples which we had in the laboratory of Merck's, Witte's, and Sargent's peptones were subjected to chemical analysis. Pressure of regular work has unfortunately prevented a completion of the analyses and a confirmation of the results; but sufficient work has been done to show clearly that of the commercial products with which we worked, Merck's brand contained the most pure peptone and the least albumose, while Sargent's brand contained a large per cent. of albumose.

Nutrient media were prepared from each of the three kinds of peptone, with all other ingredients and conditions the same. The results of several quantitative determinations of the bacteria in different waters, obtained

from this series of media, showed that the ratio of the numbers with Merck's, Witte's, and Sargent's brands was 10 : 9 : 8, respectively.[1]

Consideration of the experience of Professor Sedgwick and myself, as well as that of others, shows that not only do different brands of peptones produce different effects in bacterial cultivations, but the results with different lots of the same brand vary. The best course to pursue with regard to a standard peptone is not clear to me. Perhaps it would be wisest to defer a decision on this matter until more results are obtained by Professor Sedgwick upon his interesting work with somatose.

GELATINE.

This question has been entered into so fully by Professor Sedgwick in the discussion of his paper that there remains but little for me to say. I may add that the few tests, of a chemical nature, which I have applied to different gelatines show that the variation is marked not only in different lots, but on sheets taken from the same package. To what degree this can be obviated is not for me to say. But it seems that it would be very desirable if some arrangement could be made to take a special and carefully prepared brand, which would be satisfactory to the different workers, and have it adopted as a standard to be regularly used in the preparation of our media.

AGAR.

My experience with agar has been that it is of much more uniform composition than gelatine. In the study of the reaction of the various ingredients many tests with various indicators have been made and agar in all cases has been found to be practically neutral—a result widely different from those obtained from gelatine.

Gelatine possesses several advantages over agar as a solidifying substance, especially in species work; and were agar found to be always uniform in composition it would not be practicable to replace gelatine by it in all cases. In this connection I may mention that since July 1, 1894, glycerine agar has replaced gelatine at the Lawrence Experiment Station for the quantitative determination of bacteria in waters. This nutrient medium contains 1 per cent. agar and 6 per cent. glycerine. Nutrient agar of this composition when melted is not so stiff as that used in many laboratories, and the difficulty of having a considerable portion of the contents of the test tubes remain on the walls, after pouring onto the plate, is satisfactorily obviated.

Without going too deeply into details at this time I will point out briefly the reasons why I have adopted the use of glycerine agar in preference to

[1] These experiments have since been repeated with waters from various sources, and confirmatory results in a general way have been obtained. The discrepances have seldom been more than is indicated above; and Merck's peptone has given almost uniformly better results than Witte's, while Sargent's has given larger numbers of bacteria than Witte's in quite a number of instances and even greater than Merck's in a few cases of water from wells. G. W. F.

gelatine for this line of work. A considerable portion of the work at our laboratory, in the study of the laws of filtration, consists of careful determinations of the numbers of bacteria in water or sewage before and after filtration. Obviously the conditions of analyses of water before and after treatment should be identical. This cannot be uniformly depended upon when nutrient gelatine is used for cultivation of the bacteria. The difficulty arises from liquefaction of the gelatine after different periods of development. It is clearly an unsatisfactory procedure to compare bacterial results which in one case were obtained after thirty hours growth and in another after a growth of four days. In view of the facts that glycerine agar can be subjected to greater and more prolonged heat to insure sterilization, and that with care practically identical results with those obtained from full development on gelatine may be secured, there is little room for doubt that the employment of the former medium is a decided step in advance, so far as this line of work is concerned.

CHEMICALS.

In the paper which I have just offered to you on the reaction of media, it was noted that caustic soda (NaOH) is coming into general use for neutralization. Chemically pure reagents should always be used. The glycerine should be twice distilled. The especial point which I have in mind is in reference to carbohydrates used for fermentation tests, as in reading the replies to Circular Letter No. 1 I noted that in some instances commercial glucose was used for the gas test. Results obtained under such circumstances cannot be regarded as of permanent value, and chemically pure glucose, or better, pure dextrose or levulose, should be employed.

REACTION OF MEDIA.

Before taking up the question of preparation of media, it will be well to recall that for species work I advised that reaction No. 15, on the described scale, be taken as a standard. But standard descriptions of species of bacteria should not be confined to studies with a single reaction. The optimum degree of each species, under varying conditions of life, should be made in every case. From its intimate association with the element of variability an exhaustive investigation of this problem will probably require years of careful study.

PREPARATION OF ARTIFICIAL CULTURE MEDIA.

To serve as a basis for discussion I will give a brief outline of the methods which I have adopted in the preparation of the culture media which it seems advisable to regularly employ in the determination of species of bacteria.

Bouillon.—Meat infusion, prepared by digestion of fresh lean beef in the ice chest for twenty hours, is strained through a fine cloth. To this

filtrate is added 1 per cent. peptone and 0.5 per cent. sodium chloride. This is heated over a water bath until the peptone is dissolved. Caustic soda is then added, after the titration method which I have described, to render the solution feebly alkaline (practically neutral) to phenolphtalein. The solution is then heated over the water bath for half an hour, and filtered through cloth and absorbent cotton. Hydrochloric acid is next added to give the desired degree of reaction, after which the solution is tubed and sterilized.

Gelatine.—The method is similar to that for bouillon except that with the peptone and salt 10 per cent. of gelatine is added. The solution is heated at first only till the gelatine is dissolved, usually six or eight minutes of boiling. The only other difference is that after rendering the solution neutral it is heated for a few minutes over a free flame to bring it to a vigorous boil in order to aid in clarification.

Glycerine agar.—To the meat infusion and regular amounts of peptone and salt is added 1 per cent. of finely chopped agar. An excess of water to the extent of 50 per cent. of the prescribed volume is added and the infusion heated for one hour over the free flame. At this time the volume of the solution is about normal, and the agar is completely dissolved. After neutralizing the solution it is heated over the free flame for two hours. It is then made up to proper volume and filtered; and to the filtrate is added 6 per cent. of glycerine, after which acid is added in the usual way.

Concerning the remaining artificial media which have come into prominence and appear to be of value, they are all liquids, and do not differ essentially from bouillon in methods of preparation. Accordingly, only their composition will be noted in addition to a few passing remarks.

Dunham's solution.—This is composed of 1 per cent. peptone and 0.5 per cent. salt in water. Its chief use appears to be for the indol test.

As I have already noted I have found Sargent's peptone to be best adapted for this purpose. In fact, until I used it I never was able to get satisfactory results from the indol test, owing to the amount of indol originally present in the peptone. Whether or not there are others who have had a similar experience with Merck's and Witte's peptones I do not know. It may be that I have been particularly unfortunate in this regard. At any rate it serves to bring out a point which may be raised against, and which in part offsets the advantages of, in some lines of work, the custom of buying peptone in comparatively large lots.

Nitrate solution.—The composition of this solution is 0.1 per cent. peptone and 0.02 per cent. potassium nitrate in water.

It may perhaps be unnecessary for me to point out that care must be taken in the use, for this purpose, of this solution after it has stood for a short time in the laboratory. The reason of this is that where much gas is burned the atmosphere contains considerable nitrite, which is absorbed by the solution, thereby interfering with the accuracy of the test.

Fermentation Solutions.—I presume that in most cases in this country

Smith's formula which is 0.25 per cent. peptone, 0.5 per cent. salt, and 2 per cent. carbohydrate in the customary infusion of meat has been adopted. As Smith pointed out in 1893, the "gelatine shake" test for gas formation, which is used by many European bacteriologists without the addition of glucose, is unreliable, owing to the occasional absence of muscle sugar (glucose) in meat infusions.

NATURAL CULTURE MEDIA.

By natural culture media I mean blood serum, potato, and milk. Others have been employed, but the above-mentioned are the only ones which have come into general use.

Blood serum.—This medium has not been employed in the Lawrence laboratory, and I will leave its consideration to those who have had more experience with it than I have. I will mention, however, that the reaction of the serum should be carefully determined and made to conform with the standard.

Potato.—In spite of the fact that it was pointed out in 1886 that varying results from bacterial cultivations arise not only from differences in composition and reaction of different kinds of potatoes, but from changes in composition and reactions in the same potato during different seasons of the year, this medium is still continued in general use. Viewed in the light of my experience with the use of potato I do not understand the reason of this step.

It is true that the employment of this medium yields interesting observations, but to my mind they are of passing and not of permanent value, because there is apparently no guarantee that the same investigator can duplicate his results with other samples of potato or can describe the conditions under which he worked, so that another worker may feel sure of confirming his results. From this it is evident that I am not familiar with any method by which accurate control can be readily had of the composition or degree of reaction of potatoes. Perhaps some such method may be brought out in the discussion.

We have already noted that peptone and other ingredients of artificial media vary in their composition. This is undoubtedly a fact of grave importance. But to me the element of variability in peptones, etc., does not appear to be so serious as it is in the case of potato, and some other natural culture media. When, for instance, a year's supply of peptone is obtained at one time and from one source there is reason to believe, so far as my knowledge goes, that if the supply is thoroughly mixed the composition of this peptone will be the same at the end as at the beginning of the year. With potato this is not so. Its composition varies during the year, the degree of variation depending upon the conditions of light, moisture, temperature and the seasons. The explanation of this lies in the fact that, while peptone is a mixture of inert, lifeless, chemical compounds which retain substantially their original composition under

ordinary conditions, potato is made up of starch, water, and other compounds which furnish under ordinary conditions a varying percentage composition, in addition to changes effected by the living cells which cause the potato to sprout and to reproduce.

Viewed in this light it will appear that the biological characteristics of species of bacteria as revealed by development on potato are intimately associated with biological as well as other changes in the medium itself. Furthermore, as noted above, there does not seem to be any accurate method by which it is possible to distinguish between cause and effect in results obtained under different biological conditions coming from two sources.

From our experience at Lawrence we have found that the results obtained by the use of potato are not only of limited value, but in some cases they are misleading. The use of this medium in our laboratory was abandoned three years ago, except occasionally for comparisons of species under consideration with those hitherto described.

Milk.—From the results of chemical analyses it is clear that there is a marked variation in the composition of milk as it is originally drawn from the cow. In most instances, owing to bacterial action, additional and varying changes occur during transportation to the laboratory. Still further changes in composition, varying in degree, arise from different methods of sterilization in the laboratory.

In 1891–'92 I gave this matter considerable attention. Since that time it has been our custom to procure milk for laboratory use by sending an assistant late in the afternoon to a farm on the outskirts of the city, where freshly drawn milk has been obtained from the same cow, so far as has been feasible. This milk has been brought promptly to the laboratory, tubed and sterilized. Some difficulty has been experienced in sterilizing milk, particularly when procured from milkmen, and it has been our uniform custom to place all milk, after the final sterilization, in a thermostat at 37° C. for at least twenty-four hours. Those tubes in which there is no coagulation are used for current work.

Repeated observations on the growth of the same species of bacteria, taken from the same culture, have shown marked variation in growth in different lots of milk. In one instance I remember that coagulation of one lot of milk was effected in two days, while in the case of another sample of milk, with the same species, taken from the same culture, and developed at the same temperature, the period was seven days.

My experience with milk as a culture medium for bacteria is not so extended as I could wish. Yet from the results of my observations I have no hesitancy in expressing the opinion that it is questionable in my mind whether results of permanent value are really being obtained from the use of milk, especially in the way in which it is generally employed.

From such ideas as these our thoughts naturally turn to the question, What can be done by way of getting better methods and media? So far as milk is concerned this problem is not clear to me at present. The

formation of acid could probably be studied to better advantage in a synthesized medium containing pure milk sugar. This would not replace the observations on coagulation, of course. But I feel that there is reason to believe that sufficient careful study would result in the development of better defferential tests; and that it does not appear advisable to cling too tenaciously to old methods, which are of limited value.

I may add that I consider at present that the non-coagulation of milk by *B. typhi abdominalis* is of value in the differentiation of that germ from *B. coli communis;* and that milk, under the conditions noted, is regularly used in the Lawrence laboratory for this and other purposes.

STERILIZATION OF MEDIA.

The periods of sterilization on each of three successive days for the various media, at the Lawrence laboratory, are as follows: gelatine, thirty minutes; glycerine agar, one hour; all liquids, three quarters of an hour.

We have always employed an Arnold steam sterilizer, but are not fully satisfied with its work, as each summer there has been difficulty in completely sterilizing the media, especially nutrient gelatine.

I have ordered an autoclave, but have no experience to offer concerning its use. It appears to me, however, that no well-equipped laboratory should be without one.

Nutrient gelatine and glycerine agar are placed in cold water, to effect speedy solidification, as soon as removed from the sterilizer. These media are kept in an ice-chest, and, when employed for plate cultures, are heated for ten minutes in boiling water, just prior to their use.

PREPARATION OF MEDIA IN BULK.

Before concluding my remarks I wish to call your attention to the question of preparing media in bulk. It has occurred to several workers that this might offer some advantages both with regard to convenience and to uniformity.

I have purposely refrained from entering into the questions of special media, such as Wurtz's litmus lactose agar, and also of new media. These subjects will be taken up under questions Nos. 9 and 12.

Chairman.—Mr. Fuller's treatment of the subject deals with points which are evidently of the most fundamental character, and his paper is now open to discussion. The first point is whether we shall use distilled water. Has anyone anything to say on that point? Mr. Fuller recommends the use of distilled water.

Dr. J. Geo. Adami.—I think there is another allied subject that Mr. Fuller has not touched upon, and that is the thought that we have just the same question to determine as to whether we shall use rock salt or a pure sodium chloride. The use of rock salt containing minute quantities of many other salts has given, on the whole, better results than the use of

pure sodium chloride for some work; so that I think, under certain conditions, the former would be better. But, inasmuch as we always wish to get as near to standard methods as possible, I think there should be no question at the present time, that we should adopt the employment of the accurately known chemical. Therefore I should say that pure H_2O is the best substance, rather than any tap water, and I would support Mr. Fuller's proposal that distilled water be used.

Dr. Wolff.—I would like to suggest to Mr. Fuller the variability in the amount of free ammonia which is found in the waters; and in distilling the water, large quantities of free ammonia will pass off into the distillate.

Dr. C. N. Hewitt.—I would like to speak of what we in the West have discovered in regard to distilled water. In the water of western rivers we have any quantity of turpentine and the first portion of water we get from distillation is a mixture of turpentine, ptomaines, and toxines, etc. Now would these be desirable in the cultivation of bacteria, or would they serve as antiseptics? That is the reason why it seems to me you have run into a snag when you employ distilled water as a standard.

In the Northwest we have any quantity of artesian waters which of themselves are very admirably adapted for the purpose of bacterial cultivation. It does not seem to me that the question is so simple a matter as it may seem.

Mr. Fuller.—We use for distillation a filtered water which contains only a very little and at times no free ammonia. We put about four gallons at a time into the still, together with some alkaline permanganate, in order to break up the organic compounds. The first half gallon of the distillate contains all the free ammonia and other unstable compounds. Between two and three gallons of water, free from ammonia, which is practically H_2O, are then obtained.

Several years ago we made some experiments upon the growth of bacteria in the purest water which we could get. At that time we took the middle portion of the distillate and then subjected that to a second distillation. The middle portion of the second distillate was used for the experiments.

I have had no difficulty with any of the factors mentioned; and it appears to me that the various complications can be overcome by the application of proper chemical methods to the local conditions.

The idea occurs to me that in each laboratory comparative results should be obtained upon the influence on bacterial development of pure distilled water and the local tap water. If the latter yields similar results I do not see why it should not be used, rather than the less readily obtained distilled water.

Chairman.—Is there anything more to be said on this point? The next point is in reference to meat infusion. The relative value of meat infusion and extracts; and also the method of preparation of the meat infusion.

Dr. Adami.—I think that before proceeding to discuss these points, we ought to decide whether we will return after they have all been discussed, and vote upon them; or appoint a committee to formulate the conclusions reached.

Chairman.—It would be well to take the sense of the convention on that point. The question is whether we shall return and consider the questions after they have been discussed, or appoint a committee.

Dr. Abbott.—I move that the second alternative be adopted.

Motion was seconded and carried.

Dr. Adami.—I move that the committee be appointed by the chair.

Dr. Adami's motion was seconded and carried.

Chairman.—The next point is in regard to the relative value of meat infusion and extracts.

Dr. Abbott.—That is a point of considerable importance, and one that I think should be carefully considered. It is practically impossible to get two samples of meat of the same composition. These variations are due to the decomposition occurring in the meat in the interval of time that elapses between the killing of the animal and the date of purchase of its flesh. As this interval fluctuates, so the stage of decomposition varies. The different length of time after the animal has been killed gives results that certainly are different. The meat extract is extracted from large quantities of meat of all sorts and kinds; and I think this represents nearer a mean composition than we would be apt to get in ordinary meat as we purchase it. My own opinion is decidedly in favor of meat extract, because I believe, particularly if you buy it in large quantities, that it will not vary much; and it is very convenient.

Chairman.—I should like to ask what particular preparation you would recommend?

Dr. Abbott.—I use Liebig's.

Dr. Kinyoun.—I would like to say a word in regard to meat extracts. I believe that we get better results from meat than from extracts, by reason of the fact that one brand, Liebig's, varies so much, especially in the quantity of salt which it contains. About three years ago, I had several samples analyzed, because my attention was called to the fact that the bacteria did not grow in them. I did not know what was the matter until from the results of the analyses I found that they contained salt to the extent of 7.5, 8, and 10 per cent. respectively, and in one sample the quantity was over 15.5 per cent. Since that time I have confined myself to meat as giving the better results. For my experiments I prefer veal to beef. Veal is usually sold fresher than beef, and is not subjected to any process of cold storage. This, of course, is an advantage.

Dr. Adami.—I think that the decisions of this convention may perhaps have some influence outside of America, and I would like to say that veal among English speaking people is a very different thing from veal on the Continent. It is very often killed under six months old

among English speaking people. On the Continent the animal is usually much older when killed.

Dr. Kinyoun.—In saying that, I meant the veal which we get in Washington. It is between four and six months old. I don't think it is very young, more calf than veal.

Chairman.—It would be interesting to have the experience of others on this matter; it is a very important question. I have been using the extract for many years, and have never met with the difficulties that Dr. Kinyoun has encountered. Of course the advantage is very great in having the extract always at hand; so that, unless there is some serious objection to it, I should like to continue to use it.

Mr. Fuller.—I think that the remarks of Dr. Kinyoun are very instructive, and that his statement is worthy of careful consideration. It is also worthy of consideration whether or not the extracts have undergone changes in their preparation. My knowledge of extracts, however, is not very definite. I would like to have someone tell us something in regard to their composition, other than that of the mineral salts.

Dr. Moore.—I would like to add that in the cultivation of certain forms of bacteria, we found a greater difference in the results from meat extracts in different broths in them than from beef juice; and in the study of bacteria, as a rule, I find that a large number of these forms would not grow in media prepared from the extract. Whether that was due to chemical products, or whether it was because we did not understand the process, I do not know.

Dr. Cheesman.—I have had somewhat the same experience in regard to the cultivation of streptococci in media which were made from the meat extract, while with media which were made from meat infusion, I got an abuudant growth. I became prejudiced against the use of the meat extract, although I do use it for certain less important things and for demonstrations for the class. But for particular work I always use the meat infusion.

Dr. Johnston.—With reference to this matter I would like to say that I have repeatedly examined bacterially the St. Lawrence River water, which has a large volume and a somewhat large degree of impurity, but which is not subject to great variations. After numerous examinations of it, I found that it gave remarkably constant results in different years, although the general condition of the water appears to be inconstant. One time I used meat juice in preparation of the media, and another time I used the beef extract; and the beef extract, which was less troublesome to prepare, did not appear to give the same standard results that the meat juice, prepared from fresh beef, did.

I have not investigated the matter myself, but I have seen recently that a number of water bacteria, taken from deep water, would not grow in gelatine made with meat juice, but would grow in gelatine made without meat juice. It seems to me that the advisability of dropping both meat infusions and beef extracts should be carefully considered.

Chairman.—It seems to me that this is a point which is really open to discussion. I have been impressed, as Dr. Cheesman has, with the utility of meat extract for the routine work of the laboratory; but we make use of the meat infusion for our more particular work. I have always had an impression that it furnishes a much better medium, and, as he has observed, that some species of bacteria would not grow in the meat extract. And as no one mentions an instance to the opposite, where it would not grow in the meat infusion but would grow in the meat extract, it seems to me most decisive that the meat infusion gives the better medium. But it must not be forgotten that meat infusions contain variable amounts of carbohydrate.

Dr. Smith.—This question is certainly a very important one. It seems to me that in making culture media when one of the ingredients is a carbohydrate, the meat extract may perhaps be best. One is not apt to fail with ordinary bouillon prepared from meat, but with the meat extract one does fail to obtain any acid. The reaction commences to change when the glucose is added. For this reason the presence of glucose would be a disadvantage in some cases.

Chairman.—I agree with Dr. Smith that one should not always add glucose.

Dr. Smith.—I would say that whereas the carbohydrate is not absolutely essential to the growth of the bacteria, there are some bacteria which will not grow in bouillon which is free from it. As soon as we add a little glucose, we get an abundant growth.

Mr. Fuller.—There is one point that seems to me to be of some importance, and that is with regard to the use of eggs. One of the advantages of using the meat infusion is that it seems to do away with the necessity of the addition of white of egg for the purpose of clarification. For some time past we have obtained satisfactory results in this regard from the use of the meat infusion alone. To what extent the addition of eggs to media influences bacterial cultivation, if any at all, I do not know.

Chairman.—Has anyone any experience to offer concerning this point? It may be well to defer discussion on this point until after adjournment. What is the sense of the meeting? Shall we adjourn?

Motion was made and carried that the meeting be adjourned until three o'clock.

FRIDAY.—AFTERNOON SESSION.

Chairman.—The convention will come to order. The next thing in order is the continuation of the discussion of Mr. Fuller's paper. The point to be considered is, I believe, in reference to the kind of peptone to be used. It is to be recalled that there was a difference of opinion as to the best sort of peptone to be used, whether the use of the dark or the light would be better, and even as to the use of peptone at all. And

then there was a suggestion as to the use of compounds (albumoses) more closely related to albumen, such as somatose.

Our experience has been in favor of the Witte's as giving a better color for our media. We obtain lighter colored media with the foreign than with the American peptone. We have repeatedly found indol in various samples of peptone. Are there any remarks to be made on this point ?

The next point relates to the question of what sort of gelatine to use. Professor Sedgwick's experience with different kinds of gelatine is most interesting. We have noticed great variability in different kinds of gelatine as to their acidity and as to their solidifying points.

Dr. Abbott.—I have not noticed that the use of the gelatine as a medium is affected at all by this varying amount of acidity at different times. Whether it was formerly acid or not, it is possible to render it free from acid.

Chairman.—A point of first importance is its solidifying point, and we have found great differences in that respect in different kinds of gelatine. Some will liquefy at 22 or 23 degrees, and others will stand 24 or 25 degrees; and I should think that the committee should consider that point very particularly. As to the liquefying point of the gelatine I was not quite clear whether the hide gelatine was higher or lower than the ordinary.

Professor Sedgwick.—Lower.

Chairman.—I should consider that an objection.

Professor Sedgwick.—Yes, it is undoubtedly.

Dr. Adami.—There are very many different gelatines, and the brands by the different makers have different degrees of acidity, etc., and different effects, so that one can not be sure whether they are good. I think it should be recommended to the committee that gelatine should only be recommended for special kinds of work; but as a medium *for a general working basis* it ought to be left behind, and agar, as much as possible, substituted. At the present time, taking this notorious inconstancy of composition into account, gelatine occupies far too important a place.

Dr. Bolton.—But are not the colonies therefrom more characteristic than those from agar ?

Dr. Adami.—They should not be looked upon as being obtained from one of the media which we can say gives the most satisfactory results. They give characteristic but not constant results.

Dr. Bolton.—I would like to ask Professor Sedgwick what the advantage is in hide gelatine. I understood him to say that the hide gelatine would liquefy at a lower temperature than is the case with the ordinary brands.

Professor Sedgwick.—Simply that it seemed to be a better nutrient, that is all; and that it was somewhat lighter colored.

Dr. Welch.—The next point relates to the agar; whether it is more constant in its composition than gelatine. The difference of opinion as

to the reaction of the agar, the committee must clear up. Are there any further points to be brought up in regard to this?

Dr. Wolff.—I would like to ask the gentlemen if they have had any experience in the use of Iceland moss. That is recommended in the text-books.

Dr. Abbott.—I may say that a number of years ago I discovered that it is practically impossible to get anything profitable from its use as a medium.

Dr. Johnston.—For some months past, I have been making, in connection with Dr. J. E. Laberge, some observations upon the relative numbers of bacteria obtained from gelatine and agar cultures, from the same water samples. For getting the largest number of bacteria gelatine was preferable to agar. Often very much higher numbers were got from gelatine than agar; and gelatine would always give as many in two days as agar would in four days. With regard to the alkalinity, we found it harder to regulate with the gelatine than with agar. For field work there is a great advantage in having a medium that will not liquefy,—we are not obliged to worry about it during hot weather,—but, on the whole, gelatine, in spite of its inconveniences, seems to me to give better results than the agar.

The gelatine was used, generally at a degree of alkalinity which would correspond to 20 degrees acid by Mr. Fuller's scale.

Dr. Bolton.—I have had very similar experiences in regard to the use of gelatine and agar. I would like to ask Mr. Fuller if he does not find that the water which separates from the agar interferes with the result. I find that in glycerine agar, the water is apt to run off the medium and blur parts of the plate.

Mr. Fuller.—I would say in regard to the interference by water of condensation that we have noted that point, and have overcome the difficulty by inverting the plates after the agar has become solid. By this means the water is kept on the lower surface of the Petri dish, during the period of incubation while the glycerine agar is upon the upper surface. We have regularly adopted this custom for some time with satisfactory results.

With regard to the relative numbers of bacteria obtained from water by the use of glycerine agar and of gelatine, it is true that in two days we sometimes get as high numbers from gelatine as from glycerine agar in four days. Nevertheless the employment of glycerine agar gives us a more accurate and scientific method for this line of work.

I have already referred to this subject, and stated that as high numbers of bacteria may be obtained with proper manipulation from this medium as from gelatine. It may be added that occasionally lower numbers were obtained from the glycerine agar in the earlier stages of our experiments along this line. This was found to be chiefly due to the effect of heat at the time when the water was mixed with the medium. For some time it has been our custom to guard against this heat differentiation by

the use of a device in which the melted agar tubes are placed for fifteen minutes before use in water held automatically at a temperature of 38° C. This step appears to be a prominent feature in aiding us to get more uniformly satisfactory results from glycerine agar than from gelatine.

In the consideration of the relative advantages of the two media it should not be overlooked that the agar may be used within wide limits in the temperature at which the plates are incubated. When studying pathogenic bacteria in water it is undoubtedly of value to be able to cultivate those bacteria which grow at 37° C. on precisely the same medium as those water forms which develop only at a temperature of 20° C. or thereabouts.

Another point worth mentioning in the use of this method is that occasionally plates are obtained the surface of which is covered with a speedy growth of one or more colonies. This has not been found to be such a serious matter as would appear at first sight because by inverting the plate those colonies lying beneath the surface growers may be counted without difficulty. Compared with the trouble arising from liquefaction of gelatine this factor ranks as a very slight objection on this line of work.

While I do not consider the slower development on agar plates to be an objection to the scientific accuracy of this method yet it is a fact which is unfortunate so far as practical work goes. Just now I am studying comparatively the development of water bacteria at 20°, 30°, and 37°, respectively. It is possible that for some work the adoption of the second temperature may be of advantage.

PROFESSOR SEDGWICK.—I should like to say a word or two. The glycerine agar is not being recommended for use in all water work. The work at the Lawrence Experiment Station deals largely with bacteria in sewage and, as everybody knows, it is very difficult to handle because they liquefy ordinary gelatine very quickly. As we are constantly experimenting to a very great extent, we have found by actual comparison, that in spite of the occasional spreading colonies, water of condensation and its effect, and the somewhat less favorable effect of the glycerine agar, we do get better results on the whole than with the gelatine. It is a special glycerine agar however; not the glycerine agar of most laboratories.

There is no intention on the part of the authorities at Lawrence to insist on its use in testing the ordinary drinking waters throughout the state, or other waters, or anything of that kind. It is only these extraordinary waters, such as sewage and its effluents which contain vast numbers of bacteria, and which are very hard to handle at best, that seem to require the agar.

CHAIRMAN.—Are there any further remarks on this subject? If not, the question of the method of sterilization is next on my list. Has anyone anything to say on this point?

DR. ABBOTT.—I think this too important a subject to let pass without

comment. In this country I think the custom is to use the Arnold steam sterilizer or the ordinary steam sterilizer giving the temperature of 100° C.

In many places the autoclave has supplanted almost all apparatus for the sterilization of media; but the question is whether the high temperature which you get in the autoclave does or does not have some influence upon the composition of the media. In my own work I have not found that it influences it in any way. It might possibly be, however, that someone has had a different experience.

Dr. Cheesman.—There is one point, Mr. Chairman, that I would like to speak of; and that is the sterilization of the gelatine three consecutive times. It is the practise in the laboratory of the College of Physicians and Surgeons to sterilize the gelatine only two consecutive times, twenty-four hours apart; and I have never had any notable failures with it.

Dr. Kinyoun.—I want to call attention to one form of sterilizer that is being, I think, generally used, and that is the Arnold steam sterilizer. It is a most excellent one, but is open to disadvantages, especially in summer time. I would recommend that more than one of the ordinary burners be used. The water must be kept thoroughly boiling, not simmering; in order to give considerable force of steam you boil as much as possible if you want to have good results. I have found that out during the summer, particularly where I have used almost exclusively the Arnold sterilizer, of what seems to be known as the Boston Board of Health pattern.

Professor Sedgwick.—I presume that Dr. Kinyoun refers to the Arnold sterilizer which is of a square in place of a round form. How the name originated I do not know, but it was probably first used in the laboratories of the Massachusetts State Board of Health and not of the Boston City Board of Health. In fact, I believe it was first introduced by Mr. Fuller at Lawrence.

Mr. Mackensie.—I should like to state that in our laboratory, we use a modification of the Arnold sterilizer in which the bottom is arranged in the form of a cone. This seems to aid in heating, and has been found to be more satisfactory than the ordinary form.

Dr. Abbott.—In reference to Dr. Kinyoun's remarks, I do not see the advantage of more than one burner. Under ordinary atmospheric pressure, such as obtains in the Arnold sterilizer, one burner brings the temperature of the water to the boiling point. A multiplication of burners can do no more than this, all other conditions remaining constant.

It may be that the failure to sterilize with one burner is due to the presence in the substance under treatment of a highly resistant spore-bearing bacillus that we have encountered. Sometime since I found that the students were having failures in their efforts to sterilize with this sterilizer and a single burner,—in consequence more burners were used, but, as might have been anticipated, no higher temperature than 100° C. was reached. Further investigation of this condition resulted in the detection of the above-mentioned bacillus, the spores of which resisted this

temperature for an hour or more. I am inclined to think that failures to sterilize have been due less to scarcity in the number of burners, or feebleness in the source of heat, than to the presence of some highly resistant organism.

Dr. Kinyoun.—In reply to what Dr. Abbott has said, I would say that I tested the temperature of the steam with the thermometer, and found that there was quite a variation, and was about to throw the apparatus away as being unserviceable, when I told my man to put under some more burners and since that time we have had no difficulty whatever.

Mr. Copeland.—I would like to say that it would make some difference whether, in counting the time of sterilization, we figure it from the time when the flame is first lighted or from the time when we get a temperature of 100° in the sterilizer. It would make a difference whether we had one or six burners under these circumstances.

Dr. Moore.—In laboratories where steam is available, I find that in handling large quantities of media, the ordinary steam water bath is convenient. I find that I get just as satisfactory results very much more conveniently than by using the ordinary steam sterilizer, and the temperature is just as satisfactory as that obtained by ordinary sterilizers.

Chairman.—With regard to resistant organisms, which occasionally appear in laboratories, our experience has led us to make a more extensive use of the autoclave. We found this particularly useful with an epidemic of the bacillus which resisted a temperature of 100° for six hours. Then we began using the French autoclave. It is very convenient. Everything is sterilized in ten minutes. We even have used it for gelatine, heating the gelatine in it for only five minutes.

I think the autoclave deserves more extensive use in this country than it has received, so far as I know, at present. There is, perhaps, a certain German opposition to the autoclave. There is one point to which Dr. Abbott called my attention, which needs to be confirmed, and that is that you gain nothing by sterilizing for longer than one hour. We tried the longer process, and found that the spores of some bacilli without being actually killed were so damaged that they would not sprout out in the subsequent twenty-four hours. I think that you can accomplish more by discontinuous sterilization for one half hour at a time rather than for longer periods.

Dr. Abbott.—I think the principle of fractional sterilization at 100° C. for short periods to be correct, and do not believe anything is gained by applying the heat for more than fifteen minutes on each of three successive days.

Dr. Johnston.—There seems to be a prevailing impression to the effect that gelatine cannot be satisfactorily sterilized by a single heating in the autoclave without losing its power of setting firmly. I myself shared this opinion until one day a lot of gelatine was, by mistake, sterilized in the autoclave under pressure and was found to be perfectly serviceable and firm. I find in Thoinot's *Précis de Bacteriologie* the statement that he has

for years employed gelatine sterilized at 105° C. and found it satisfactory. Lately in my laboratory we have tested this further by dividing one lot into two sets, one being sterilized in the Arnold apparatus on three successive days and the other placed for fifteen minutes in the autoclave at one half an atmosphere pressure (or even as high as 115° C.) for fifteen minutes. The gelatine so obtained has been found just as firm as that sterilized at 100° C. remaining solid at 24° C. and in some cases at 25.5° C. and the reaction at the end of the process being acid No. 20, identical with that sterilized at 100° C.

Dr. Bolton.—I have used the autoclave for the sterilization of gelatine, and so far as I know the results have been thoroughly satisfactory.

Chairman.—We have already touched upon the question of changing reaction of media owing to the sterilization. Is there anything further to be said on this point?

I wonder if any of the gentlemen have had the experience, which we have had at Baltimore, that meat broth containing glycerine becomes more acid upon sterilization.

Dr. Swarts.—I was taught that the cleaning of glassware is an important feature in bacteriological work. It occurs to me that it is well to always wash test tubes, etc., in soda or acid solutions. It is my opinion that we should look more closely after such details as these, if we are to obtain satisfactory results.

Chairman.—That is a point worth considering but it should be remembered that care must be taken if chemicals are employed for cleaning, to remove them completely or the reaction of the media may be changed by them. Is there more to be said on this subject? The next point is in regard to the question of the use of potato. What is the opinion on that?

Dr. Abbott.—I cannot agree with Mr. Fuller in regard to potato. I consider the potato a most useful medium. It is true that it is very difficult to get exactly the same reactions or the same conditions of growth from half a dozen specimens of potato. It is impossible. I have tried to get over this difficulty and I think that perhaps the best method is to employ mashed potatoes. In that way we get the mean composition and the mean reaction of a number of potatoes and get moderately constant results. I agree with Mr. Fuller as to the inconstancy, but I should regret to see the potato given up.

Dr. Smith.—A decision on the use of those media which have both advantages and disadvantages will require much care; and I would suggest that the points noted by Dr. Abbott be taken into consideration by the committee, in regard to the use of potato.

Dr. Moore.—I wonder if any one has had any experience with sweet potatoes. This was suggested to me by a friend, and he said that in his experience he found that the difference in reaction was largely overcome in the sweet potato; and that it did furnish a valuable medium.

Dr. Prudden.—Two or three years ago we used the sweet potato to a

limited extent; but I don't think we noticed that it was superior to the ordinary potato. Its reaction was perhaps more constant.

Dr. Abbott.—There is one more thing I would like to ask while we are on the question of potatoes, and that is, if any of the men have had any experience in the use of the artificial potato. It is simply a mixture of different starches and different salts dissolved in water and sterilized. We have attempted to use it, but with not very successful results.

Mr. Mackensie.—I tried some experiments, but could not get any results at all from it.

Chairman.—This method was tried by Dr. Russell, who worked with me for some time. He did not find it to be satisfactory, and finally abandoned it.

I think that it would be a great loss to abandon the potato; but it is true that it is a very inconstant medium. There is, however, a good deal more to be looked for than the mere fact of bacterial growth on potato. The gas production is an important point; and also the presence or absence of discoloration of the potato which varies in different varieties of bacteria; and the extent of the growth.

The usual idea that the inconstancy of the growth on the potato depends wholly on the varieties of reaction, I think is not true. Several Italian bacteriologists have found that the typhoid bacillus does not give an invisible growth on potatoes raised in southern Italy, while the cultures of this organism showed the characteristic growth on potatoes coming from the vicinity of Berlin; and it is not true that their potatoes are uniformly more acid than the potatoes of Berlin. It is something therefore in the composition of the potato; but what it is I am not able to explain.

We have found it to be a decided advantage in comparative work to make use of the somewhat ancient method of cultivation on potato, where you have the two halves of the same potato. This is especially useful in the study of the typhoid bacillus, by putting on one half of the potato the stock culture of typhoid of known identity, and on the other half the organism under consideration.

I think that it is still very useful to study potato growth in that particular way. We have found in Baltimore that the typhoid bacillus grows often invisibly, but sometimes visibly, and we make a great deal of use of the potato in differentiation of the typhoid bacillus. I believe that there still remains a field of usefulness for this vegetable.

The use of milk as a culture medium is the next question in order. Mr. Fuller thinks it of limited value.

Dr. Cheesman.—I think, Mr. Chairman, that the use of milk in certain cases is of great value. The coagulation of the milk is a very marked characteristic in the differentiation of species, as is the formation of acid in the milk, and the time in which that acid is formed. All these are, I think, important. I should be very loath to give up milk as a culture medium.

Dr. Abbott.—I think that milk is equally as important as any of the other media. The coagulation and non-coagulation, the reaction, etc., are all important factors in identifying species.

Mr. Fuller.—It is possible that I did not make myself clearly understood this morning concerning the use of milk and other natural media. My ideas obtained from experience at Lawrence were given largely with the view of facilitating discussion and of finding out, if possible, the opinions as to the value of replacing these natural media by new and better ones. I did not recommend that milk or potato be universally abandoned. In fact I do not consider that such a step would be advisable until we see our way clearer with regard to the use of uniform synthesized media, capable of accurate definition and control. It was not at all my intention to give the idea that the present media should be absolutely done away with at once.

Chairman.—We have heard the additional statement concerning Mr. Fuller's views on this subject. Is there anything more to be said?

Dr. Adami.—Under the present circumstances it would seem advisable to me that we devote more of our efforts towards the establishment of new and better methods. It is clear that we should not give up old methods now in the absence of sufficient information concerning new ones. To me it would appear that the replacement of old methods is a question to be decided in the future rather than at present.

Chairman.—The object of this convention is especially the determination of a plan for having methods which can be used universally and which will give fairly constant results. With gelatine we cannot be quite sure of anything. The use of different gelatines also may give diferent results, so with potato, so with other things. There are a certain number of media which we can recommend to each other as giving constant results.

Dr. Abbott.—In regard to milk, if it varies so very much we might endeavor to obtain an artificial milk, but one that will do better than the artificial potato has done.

Dr. Moore.—I think that tests of value in milk can be well established from the study of the physiological properties which bacteria possess in the way of fermenting, digesting, and coagulating it. Part of the observations of course can be obtained in bouillon, but there are certain other things that it is very difficult to get from any other medium, which we now have, that we can get very readily from milk.

Chairman.—I quite agree with what Dr. Cheesman says in regard to milk. There are many points to be considered in milk culture. There are the delicate changes of the reaction toward the litmus. There are the different periods of coagulation, the different characters of the coagulum, the clearness or turbidity of the separated serum, and in litmus milk the various color tints of the scum at the surface. I am working now with a kind of pseudo-diphtheria bacillus which can only be distinguished readily from the diphtheria bacillus by its production of alkali in milk.

Professor Conn.—I think, perhaps, that I have had as much experience with milk as any one here. I thoroughly agree with the chairman that milk does give a great many of these delicate tests. The coagulation of the milk may serve to separate two wholly different kinds of bacteria from each other. As I suppose you all know, the coagulation of milk by bacteria is effected in two quite distinct ways. There is one class of organisms which produces an acid fermentation of milk sugar, causing the milk to coagulate; and another class which slowly produces an alkaline reaction,—sometimes in a week and sometimes longer—and effects coagulation by a sort of chemical ferment or enzyme. This enzyme has almost the same qualities as the rennet from a calf's stomach; and it serves to coagulate milk in a way that gives in many instances a radically different appearance than is obtained from the coagulation by the first-mentioned class of organisms. The reason of this difference is that commonly these enzyme-producing bacteria develop a second enzyme with tryptic characters and which digests the casein. The action of this peptonizing ferment differs widely with different species and under different conditions. Sometimes the casein will remain absolutely the same for months before it begins to digest. In some cases the digested fluid will be brown, amber, purple, blue, pink, or violet; and then again in other cases it will give what seems to be almost identically the same result as from coagulation when acid is produced.

By the action of some species of bacteria it is found that after two or three days, and when no coagulation has taken place, the milk becomes somewhat transparent, and sometimes every trace of whiteness will be gone. Under these circumstances similar characteristics are developed, as in the case where the curdled casein is digested, and the various colors just referred to are obtained. Although no coagulation takes place a certain amount of rennet ferment is produced, as I have learned from several experiments where I have taken such milks and treated them by the proper chemical methods. While the rennet ferment was present the quantity was insufficient to effect coagulation in the presence of the more rapidly-formed tryptic ferment. From the result of these experiments I know that two separate ferments in milk are produced by the action of bacteria; one causing coagulation and the other peptonization. I have also been able to show that coagulation, or separation of the casein, in all cases is not a separation by acid but is the result of a chemical change which has taken place in the casein. It may also be added that the transparency of digested milks is due to the dissolving of the caseine, which gives to the milk its original color.

My own experience has been that just as with some other media, milk is a very difficult thing to get constant results from. It is very difficult to sterilize, and you get erroneous results from unsterilized milk; and then, if you set it in your laboratory, after putting it through the process of sterilization, in the course of two or three weeks it is possible when

your tubes have not been inoculated, that if you put them in the culture room, often just as likely as not, one may be cultured, and the other may not. So that from time to time during my work, I have found it extremely difficult to rightly point out the conclusions from my experiments because of this difficulty of obtaining results of any certainty. You can tell whether bouillon is sterilized, or gelatine or milk, if it curdles, because you know it has not been sterilized; but you may have milk that looks perfectly right and yet is not sterilized at all. You have to be pretty careful in using it as a culture medium.

Dr. Cheesman.—I think that milk may be thoroughly sterilized by three consecutive sterilizations, of twenty minutes each. I have adopted that method of sterilization in my work, because I have found that a very long exposure to the heat causes a darkening of the milk. I have found that twenty minutes on each of three consecutive days will thoroughly sterilize milk.

Professor Sedgwick.—I teach my classes regularly how to make artificial milk. It looks just like ordinary milk.

Professor Conn.—You can make a medium that looks exactly like milk, and it is just about as white as any milk. Milk that is run through a separator has had all its fat separated from it. It is quite distinctly white, but this is due to the casein, which is not held in solution, but in a state of suspension, and in some instances there are phosphates that aid in producing the whiteness.

Professor Sedgwick.—What becomes of the fat?

Professor Conn.—Usually, it rises to the surface in drops of oil.

Dr. Smith.—I have found a bacillus just as you described. We can not convince ourselves that there is any more fat on the top than in any ordinary milk. You can take ordinary milk and add caustic soda and get the same effects.

Chairman.—The only other point connected with this question is, I believe, as to the addition of glucose to media. A great deal has been said in reference to that. Is there anything more to be said? Perhaps Dr. Moore can give us some additional light.

Dr. Moore.—I do n't know that I have anything special to say on that subject. Glucose is a very important ingredient, and yet there are instances in which it is desirable to have media free from glucose.

Dr. Abbott.—The question was brought up this morning by Mr. Fuller, and he suggested that we might endeavor to get, as nearly as possible, a uniform quality of glucose. Is it possible to obtain chemically pure glucose? I have never ordered any.

Dr. Moore.—In our laboratory we order it from a dealer in town, and have been supplied with a substance said to be such.

In regard to getting bouillon that is free from glucose, I would say that a practice that we follow is to test all bouillon, before it is used for any purpose, in the fermentation tube, in order to determine the presence or absence of the glucose in it; and we know always whether the forma-

tion of the gas is due to glucose originally present. There is a great deal of difficulty in obtaining meat free from this glucose, and we have found, in some cases, that where the meat has been taken from small animals immediately after being slaughtered, and put at once in small pieces into boiling hot water, we had no glucose.

Dr. Wolff.—I have a word to say in regard to the filtration of culture media. That is an elementary piece of laboratory work; still my experience has led me to the use of sterilized asbestos wool, which can be obtained from H. W. Johns, 87 Maiden Lane. I find that by using this sterilized wool, you obtain a very clear medium, and you will be enabled to heat it to a red hot point, so that it is certain that it is perfectly sterilized. I have found it exceedingly useful, as giving a very clear filtrate, and especially for the filtration of the differentiated serum.

Mr. Fuller.—There is another point to which I wish to call attention, and that is the preparation of media in bulk. The question of the preparation of large quantities of media at once is a very important one it seems to me, and so far as the matter of uniformity is concerned might have considerable significance in some lines of work.

Chairman.—The question of the preparation of large quantities of media at once is brought up for discussion. Has anyone had any experience, or any suggestions to make in reference to this?

Dr. Adami.—I have had a little experience in this matter, and can recommend the use of special flasks such as are used at the Pasteur Institute. These flasks contain half a liter or a liter and have necks a foot or more in length. The necks can be drawn out about two inches above the bulb before filling and after sterilization the flasks are hermetically sealed. This will keep bouillon very well indeed. I have kept large quantities of it for years. It should be kept in a dark room.

Dr. Moore.—It seems to me that in regard to the question of storing media in large quantities, there is no advantage unless we can have some way in which the medium can be readily put to practical use. If we have to consider the question of re-sterilizing it on account of contamination from transferring, we gain nothing. But Dr. Dawson has been experimenting with this difficulty, and he has found that he could transfer bouillon and also agar from half-liter flasks successfully by the aid of a specially prepared tube. He places the tube in a sterilizer before using it.

Dr. Park.—I might say, Mr. Chairman, that in our diphtheria work we have found it to be an advantage to use agar.

Prof. Sedgwick.—I would like to say for the benefit of those who want to get specially pure substances, such as glucose, glycerine, etc., that I happened to be talking with one of our most distinguished chemists, and the conversation somehow fell on that sort of thing. He recommended me to Schering & Glatz, 55 Maiden Lane. He said that he had obtained from this firm some reagents which were remarkable for their purity; good enough to work upon for the highest forms of scientific work. And he said in reference to glycerine and things of that sort, that

if this firm happened to keep that, it would probably be the best place to get it in the United States. This suggestion of course is offered in an entirely disinterested way.

Chairman.—The next paper is by Professor Jordan of the University of Chicago, on: "What shall be the medium for and the conditions of the stock culture from which all media are seeded"?

Mr. Fuller.—Professor Jordan is unable to be present to-day. Several days ago I had the pleasure of seeing him and he wished me, as a member of the committee, to say that it was with sincere regret that he found that it was impossible for him to come to New York to attend the convention.

We spoke at some length on the subject which is embraced in this question, and it was his opinion that the stock culture should be grown on agar of the standard formula adopted by this convention. With regard to the conditions he recommended that a twenty-hour culture grown at 37° C to be used for stock culture for seeding. In the case of water bacteria which do not grow at blood temperature it would be well to use four-day-old culture at 20° C. A complete description of water species should contain an account of seedings from each of the conditions. Professor Jordan also advised that all stock culture should be kept in the dark.

Dr. Mackensie.—This does not include, I believe, the best method of keeping the culture.

Mr. Fuller. With particular reference to the culture in the future? I do not remember that this point was mentioned by Professor Jordan; but I believe that it is his custom, as is mine, to keep stock cultures in the dark at room temperature.

Chairman.—In studying the characters of bacterial growth on different media it seems to me impossible to lay down any definite law as to the period of the growth at which these characters shall be described. It is important that they should be noted at various stages.

Mr. Fuller.—It is not quite clear to me, Mr. Chairman, whether you refer wholly to the influence of the stock culture, or whether you also have in mind the question of constancy in the results of growths and morphological characteristics of species in the same medium. The latter points I presume will be considered under the following questions on our programme.

With regard to the influence of the stock culture I would say that when the custom is followed out of transferring stock cultures to fresh media once in two weeks I have not noticed that more than one additional fresh culture is necessary in order to obtain a satisfactory culture for seeding. And from what Professor Jordan has told me of his extended studies upon the continuance of life of the typhoid bacillus under different conditions I should judge that his experience has been similar to mine. This experience, however, may not be uniformly obtained under all conditions and your suggestion is doubtless a valuable one.

I think that perhaps I might add here that with regard to the advantage of a stock culture under standard conditions I have obtained some interesting results from the study of the fermentation of carbohydrates by a species under different conditions. Last autumn a gas-producing bacillus, belonging to the colon group, was isolated from the Merrimack river water. By accident this culture was not transferred to fresh medium for six weeks, during which time the original culture on glycerine agar was kept in the dark. At the end of this period it was found that the culture would produce only a very slight amount of gas in a glucose solution, under the conditions regularly practised in our laboratory, whereas it originally had produced from 60 to 80 per cent. and I was much interested to note that after passing this species rapidly through fresh cultures on glycerine agar that in a week or so its power of gas production was practically restored. Since that time the culture has been transferred every two weeks and it still retains it normal power of gas production.

Mr. Mackensie.—I would like to state my experience as to certain forms of bacteria. There are one or two forms which grow in almost every water, and which in gelatine tubes form a stocking or a funnel shaped growth. On reseeding for a considerable number of times on this medium, they grow more funnel shaped, and the only explanation that I can give of it is that by starting from the surface, they are brought more in contact with the air, and growing in this particular way a portion becomes so adapted to these conditions that they form a race. This race then becomes accentuated over the original type in such a degree that a change in form of growth is produced.

Chairman.—Have you had the experience of which Petruschky speaks, of keeping the stock cultures in an ice box? They will last, I believe, apparently for an indefinite time when kept at that temperature.

Dr. Cheesman.—The temperature of an ice box is about 45° F.

Dr. Moore.—That is a custom that we have followed in our laboratory. We keep stock cultures in a large box containing a piece of ice weighing from fifteen to twenty pounds. I inoculated a rabbit week before last with the usual quantity of bouillon culture that had been kept in this way since 1891, and found that it had retained its morphological characters and the same degree of fermentation. We use the ordinary test tube and employ either agar or gelatine. We keep cultures all the way from two or three weeks up to two or three months.

Chairman.—The next paper is by Professor Sedgwick, on What shall be the systematic detailed method to be followed in observing the results of cultures and the manner of recording them?

Professor Sedgwick.—I am not prepared with any special paper on this subject, as it seems to me unnecessary to speak on it at length. I am very much interested in this matter, however; and in the first place from the biologist's point of view. The difficulties in which biologists find themselves are mainly due to the fact that we are obliged to depend on physiological characters for the most part; and therefore the systematic methods

of observing and reporting the results of cultures are of the highest importance. As these are necessarily indefinite, it is all the more important that there should be a few clear cut things that would be of decisive value.

It is not sufficient to say that one has found a liquefying bacillus; and there are too many descriptions resembling this which really amount to nothing.

But as for the systematic method to be followed, I do not believe that we have got beyond the actual practice of the best workers of to-day. If we take the results of any good bacteriologist and see how he describes his species fully and carefully, with obvious attempt to be accurate in observation and full in his report of his conditions, I doubt if there is anything to be added to that. But whether the committee had in mind some systematic blank which should be filled up, I do not know. I think it is very possible that something of that kind might be advised by the committee.

My own feeling is that the main thing is just what it is in other departments of science: in the first place, careful observation,—which is simply to see the things that are there and to put the organisms under conditions so that the natural result will be as far as possible a correct one,—and then, in simple and accurate language, to describe the differences and the mean required to distinguish between them,—those, of course, being the regulation things. Fullness also is very important.

The discussion to-day has well brought out the fact that we can't afford to do away with any one of the present tests at this time; but on the other hand, we ought to devise new and better ones. Still, at best, we are depending upon very treacherous things, physiological characters, things which are variable and therefore correspondingly untrustworthy.

And so, with these very few and I fear very dry remarks, which may perhaps suggest nothing new, I leave the matter with you.

Chairman.—Professor Sedgwick's very interesting statements have been heard. The subject is now open to discussion.

Dr. Cheesman.—Mr. Chairman, I would like to say that I think it would be a very good thing to have some kind of a chart or table worked out, on which everything could be placed by the different workers in the same uniform standard way. I think it is only by some such plan that the different appearances which occur in bacterial growths can be definitely and accurately recorded. I believe it is perfectly practicable to get up such a chart.

Dr. Swarts.—I move that this subject be referred to the committee.

Professor Conn.—I think that the plan of having a standard chart is an excellent one and I would second that motion.

Motion was carried.

Motion was made, seconded, and carried that this committee consist of five members, and that the chairman be one of them.

Chairman.—Next in order comes a communication upon the nomenclature of colors from Professor Shuttleworth of Toronto. (See page 403.)

Dr. Adami.—It seems to me that this point of nomenclature of colors might appropriately be submitted to the committee and I would make a motion to that effect.

Motion was seconded and carried.

Chairman.—Next in order comes Dr. Cheesman's paper.

Dr. Cheesman's paper. (See page 400).

Chairman.—Dr. Cheesman's very able and instructive paper, on What method shall be adopted by which full benefit may be derived from morphological characteristics, is now open to discussion.

Dr. Park.—Should not there be several media rather than one? One special medium might be good for one form and poor for another form. If we had several media we should get a better understanding of the organism in question.

Professor Sedgwick.—I think that there is some danger in the present state of bacteriology, that we shall become adherents of polymorphism,—that doctrine which De Bary did so much to upset.

We hear a great deal nowadays about the varieties and the modifications of the forms, etc.; but it is well once in a while to see what the other side is. I think the other side is, that there is not as much variety and polymorphism as we think; and that as a matter of fact, with normal media there is not as much variation as we think there is. If our media are not adapted to that particular organism, it would be one of the least difficult things to overcome, in my judgment; and yet I think it is one that must be wrestled with. As I see the descriptions of varieties and hear the talk about them, and as I recall the history of the subject, I can't help thinking that we are a little in danger of running into the pit of polymorphism.

The only thing is to determine, if one can, what the form is; and it is a very difficult thing to do. For instance, it is often a question whether bacteria are in the highest state of development in the cycle, or whether they are simply passing forms, temporary forms, and reach their highest state in the zoogloea stage. When we describe them we must be exceedingly careful to be sure that we have exhausted every possible means to study their development. And therein, it seems to me, lies the great labor of the committee on this particular subject. If we go wrong on our morphology, it seems to me that we shall get into trouble. We must stick close to those means we are sure of.

Professor Conn.—It seems to me that the committee should describe some definite conditions under which morphological characteristics shall be determined and that it also ought to tell the age of the cultures to be examined. Morphology differs more with age than in any other way. In the case of one species that I have studied, taken from a culture that is several days old, it is so short that it might properly be called a micrococcus. When it is two days old, it grows into very long threads of bacilli. Of course the age of the culture has not so much absolute importance as the culture medium itself. Wherever the culture is old I get

great, long folds, but I do not get it for cultures under any other conditions.

Chairman.—In the demonstration of spores, it seems to me that we need to combine the physiological test with the morphological one. It is necessary to determine at what temperature the spores of a species are killed. It seems to me that it would be well to consider the resistance of spores under a number of uniform standard conditions. Probably you have all had the experience that it is difficult in some cases to arrive at a correct decision on spore formation from the appearance of preparations made by current methods of staining. Is there anything more to be said on this subject? If not we will listen to Dr. Johnston on the tests to be used for separating bacteria into clearly marked groups.

Dr. Johnston's paper. (See page 445.)

Chairman.—We have heard Dr. Johnston's interesting contribution which is now open to discussion.

If there is nothing further to be said a motion to adjourn would be in order, as it is getting late.

Motion was made, seconded, and carried that the convention adjourn to meet at 10 o'clock on Saturday morning.

SATURDAY MORNING'S SESSION.

Chairman.—The convention will come to order. The next thing on our programme is the paper of G. M. Sternberg, Surgeon General, U. S. Army, on the method to be followed in determining the relation of bacteria to temperature. Dr. Smart will read this paper.

Dr. Sternberg's paper. (See page 411.)

Chairman.—Dr. Sternberg's paper is now open to discussion. It relates chiefly to the methods of determining the thermal death point in bacteria.

Dr. Bolton.—The only suggestion that I have to make is, that in considering the diameter of the tube, we should also consider the thickness of the glass.

Dr. Mackensie.—In determining the thermal death point, would it not be possible to use a sterilized thermometer?

Chairman.—It seems to me that the determination of the thermal death point should be considered one of the routine tests, just as much as the growth upon any one medium.

I was a little surprised to find that Dr. Sternberg is inclined to recommend the test tube instead of the capillary pipette. It seems to me that there is a great advantage in the use of the capillary pipette. It transmits the temperature in a very short time, while with fluid in the test tube it takes a longer time. Our custom is to use the Sternberg pipette, four or five centimetres in length, with a small bulb at the end. That, of course, is sterilized and at the same time hermetically sealed. Dr. Sternberg very properly emphasizes the point of having the pipette lie in the fluid adja-

cent to the bulb of the thermometer. I think that is very important. These capillary pipettes are inclined to float in the bath—so that we have a little wire gauze arrangement by which the end of the tube catches and is held there, and here the thermometer lies.

You all know how difficult it is to control the distribution of heat in the fluid. We use a large volume of fluid, so that the temperature will not vary much during the period of observation.

Perhaps Dr. Sternberg did not note one thing which may be a trifling one, but which it is well to know if one uses the capillary pipette, and that is the great importance of immediately cooling the tube as soon as removed. If that is not done, the results will not be absolutely correct. Thrust it at once into ice water, so that the temperature does not act upon it any longer.

Dr. Abbott.—In this connection, Mr. Chairman, I should think the smallest possible amount of fluid should be used for the accuracy of the experiment. I should think that five cubic centimetres would be too much.

Dr. Welch.—There is possibly one other point which should be brought out. It is well known from the works of Geppert and Behring that certain organisms which are damaged by the action of corrosive sublimate, carbolic acid, and other agents of an injurious nature will not grow in agar or gelatine but they will grow in bouillon. The test may be made by planting the fluid in bouillon, but in that way one only determines whether all have been killed.

The manipulation of these capillary pipettes is very simple indeed. I confess I should like to see the capillary pipette used in preference to the test tube.

Dr. Kinyoun.—With regard to the use of the test tube to determine the thermal death point, I have been always favorably inclined to the Sternberg pipette. I have used a special test tube of about seven inches long by one-fourth in diameter, for this purpose, immersing this into the bath. This method has given me very constant results,—much more so than if I had used the one-half or three-fourths inch test tubes. I have found that there is quite a variation in temperature of the liquid when these are used, but there is very little if any when a smaller test tube is employed.

Mr. Fuller.—I would like to add, Mr. Chairman, that, in addition to the important subject of the thermal death point of bacteria, there is another point worthy of attention in the relation of bacteria to temperature. I refer to what is called the optimum temperature of development of bacteria, together with possible variations in the same.

For several years we have given considerable attention to the study of the amount of gas formed in the fermentation of carbohydrates by different species of bacteria, and especially by members of the colon group. Notable differences in the amount of gas formed have been found in the case of freshly isolated cultures from fæces and from fresh cultures of the

same species after it has been allowed to remain at room temperature for several months. During this time the cultures have been transferred to media several times; but it has been noticed that under the latter circumstances considerable more gas was produced, when the fermentation test was made at 20° C., than by the same species when it had just been isolated from fæces. We have given the question of composition of fermentation solutions much attention, and under the same conditions, so far as has been learned, this increase in the amount of gas obtained from fermentation at 20° C. has been repeatedly observed.

On yesterday I referred to a somewhat similar experience along this line, and which is of interest in this connection.

Mr. Mackensie.—I have had a somewhat similar experience with an organism that at first would not grow at all at 37° C. I tried the experiment of putting it into agar and letting it remain in the room temperature for a day, at 37° C. for a day, and the third day at a lower temperature, and then put in the incubator for a day. I found that the culture would then grow as well at 37° C. as it would outside the incubator.

Chairman.—It seems to me that this point is well worth consideration. What shall we consider as evidence that a given temperature is the optimum temperature? I always prefer to have my thermostat slightly below 37° C. rather than above. I am apprehensive that there are certain organisms that lose their characteristics very quickly, and I think organisms will grow more rapidly at 37° C. than at a little higher temperature. But it is a question whether rapidity of growth shall be regarded as evidence of the optimum temperature.

The next number on our list is the paper by Professor Jordan, on "What special methods are of value in the isolation of pathogenic bacteria in water?" Has anyone had any communication from Professor Jordan? If not, it remains for Dr. Abbott to tell us his views.

Dr. Abbott.—The portion of the discussion that has been assigned to me admits of little that is new being said. I shall, therefore, in an informal way, dwell for a few minutes upon those features of the work, as already practised, that I consider as important and as worthy of discussion. Hitherto efforts to isolate pathogenic bacteria from water have been directed against but one or two species and the general study of water from this standpoint has not, so far as I am aware, been made. It is true, the subject might be dismissed in a few words by simply advising the employment of the same measures that are used for the isolation of disease producing organisms from other sources. It is with the hope, however, of eliciting from the members new views upon this question, that may be based upon special methods that are peculiar to their own laboratories, that I present what I believe to be the salient points to be considered.

Since we have learned that many of the saprophytic species common to waters do not develop readily at the temperature of the body, it seems hardly necessary to emphasize the advantages to be gained in eliminat-

ing these forms by the employment of a temperature of from 37° to 38° C. It is manifest that it is among the species that develop at this temperature that one is to seek for the pathogenic varieties. This temperature may be employed from the start with the ordinary plate method or with some of the modifications of the method of Schottelius in fluid media.

Another point that is, I believe, of importance and which has been more or less ignored, is that relating to the character and strength of the nutritive medium employed. From work that has appeared from time to time there is reason for believing that the isolation of pathogenic species from mixtures consisting largely of saprophytic forms is sometimes simplified by the use of weaker or stronger nutritive media than that made by the standard formula. On this point, however, there is still room for investigation. The importance of attention to reaction has already been ably presented by Mr. Fuller.

Where pathogenic species are as rare as we have every reason for believing them to be in water, it is plain that a method that will enable us to deal with the organisms contained in or separated from a larger bulk of water would be of great advantage. It has occurred to me that it might be worth our while to endeavor to devise methods for this purpose. I have recently been trying to accomplish this through sedimentation, assisted by chemical precipitation and by mechanical separation as seen in the process of filtration through sand. In the former case it is the sediment that is to be investigated; in the latter it is the upper layers of the sand. As yet I have not obtained sufficient evidence of their value to justify me in recommending either of these procedures, but I mention them with the hope that they may serve as suggestions for a line of work through which a useful method may be elaborated. Having separated from water by a suitable method those species that develop at body temperature there remains to test their disease producing properties. This must of course be done with pure cultures, and by any or all of the usual methods of inoculation, and upon the different animals commonly employed for these tests. More care should be given to the description of pathological lesions, local or general, that may be produced; and a negative opinion should not be reached from a single mode of inoculation or from trials made with one species of animal. I am aware that it involves much labor but if these determinations are to be made they should be thorough, and the organism under consideration should not be pronounced non-pathogenic until subcutaneous, intra-peritoneal, and intra-vascular inoculations in rabbits, guinea pigs, and mice have shown them to be so.

Just here I wish to enter a vigorous protest against the adoption of a method for determining this point that has received some support. This method consists in inoculating animals with the growth that results after adding to fluid culture media various amounts of suspected water. This test is never with pure cultures, or only accidentally so, and cannot,

therefore, as practised afford any information of value. It is a slipshod method and with the best intentions cannot be considered as scientific. It is true that animals were employed by Koch for the separation of pathogenic species from mixtures believed to contain them, but if this method be adopted I trust the members will realize the importance of testing organisms so obtained in pure culture, for of a mixture of species one may be capable of inducing disease through the aid of organisms with which it is associated, or the products of their growth, but may fail to exhibit this power when tried alone in pure culture.

It might be of interest to decide if any of the species that do not develop at body temperature, and are, therefore, incapable of infecting, have, nevertheless, the power of producing as a result of their nutrition, at temperatures suitable to their growth, products which when introduced into animals are capable of manifesting toxic properties.

For the determination of pathogenesis I do not see that we can add anything to the methods already generally practised. For the sake of uniformity we might begin with the employment of pure cultures grown under the same circumstances for the same length of time, but we cannot of course lay down hard and fast lines for the control of this test. Species may occur that vary in the degree of their virulence according to their age, or may exhibit more or less disease producing power on one medium than on another. With unknown organisms the detection of pathogenic properties is a matter of experiment and a negative opinion should not be reached from any single test.

What has been said relates to the general study of water with the view of detecting unknown pathogenic species. With the exception of the bacillus typhi abdominalis and the spirillum choleræ Asiaticæ pathogenic species have been found in water so seldom that it is rare for one to examine water with the hope of finding disease producing forms and thus far practically all examinations from this standpoint have had for their object the detection of one or the other of the organisms mentioned. As a result special methods have, as you know, been devised for the purpose. In the case of the cholera spirillum these have been a success, but in so far as my own experience goes and from what I can gather from the experience of other reliable bacteriologists, none of the special methods for the isolation of the typhoid bacillus have proven themselves to be entirely trustworthy.

Chairman.—The question is now open for discussion. The chief point is, whether any one has any elective media in particular to recommend.

Dr. Kinyoun.—In connection with the isolation of bacteria from water, I wish to detail some experiments which are now being carried on in the laboratory of the Marine Hospital service by Dr. Andrade, one of the assistants. The work is not yet completed, but it presents some points well worth giving, and one is that he is using a standardized bouillon, slightly colored with a definite amount of acid fuchsine. It is true that quite a number have used this in the differentiation of typhoid and other

bacilli, but I do not believe that it has been used exactly in the way that Dr. Andrade has employed it. Dr. Dunham's peptone solution containing 6 per cent. of glycerine has been found to give the best and most pronounced reactions in the differentiation of the typhoid from other intestinal bacilli. The media must be prepared fresh—because it loses some of its sensitiveness on standing. When the colon bacillus and typhoid bacillus are planted in this bouillon, a marked change occurs in the color, depending of course upon the amount of acid the two cultures produce. At the end of twenty hours the colon bacillus has changed the bouillon to a deep red whereas the typhoid culture shows but little or no change. The reverse can also be obtained with a similar bouillon, which has been decolorized by an alkali. The proteus can also be differentiated from the others, as it produces a large quantity of acid within a few hours. The experiments have been conducted with cultures from several sources, and have given uniform results. So this cannot be considered a reaction given by the cultures of but one laboratory.

The spirilla can also be differentiated by the same method, with the details of which I will not burden you, suffice it to say, that the reactions are as clean and distinct as those with the colon and typhoid bacilli. I would like very much to have these experiments confirmed by other investigators. As I say, the work is not finished; so far it certainly promises to be a valuable aid in differentiating the spirilla and intestinal bacilli. I think Dr. Andrade will be able to finish his experiments in the next two months.

Dr. Abbott.—I would like to ask how he decolorizes.

Dr. Kinyoun.—By an alkali—caustic potash.

Chairman.—I have notes on the reactions of the hog cholera bacillus, the typhoid bacillus, etc., on media, colored by about eighteen or twenty different aniline dyes. Some of the reactions were very pretty, but not of great value on account of considerable inconstancy, and a good deal of influence on the results by the composition of media.

I think it is one of the most encouraging things to us that we have at last a method for the isolation from water of the cholera bacillus—one of the most important among the pathogenic bacilli; but on the other hand, it is a source of regret that, as matters now stand, we have no similar mode of procedure for the typhoid bacillus.

Dr. Abbott.—I would like to say in connection with the use of Wurtz's agar, that I have used the typhoid cultures in this way for years in the course of my work; but I have only in a very few instances had the culture of typhoid bacillus give me definite results. The results have been most inconstant.

Chairman.—I think the general feeling now in regard to this matter is one of uncertainty as to whether anyone has ever isolated the typhoid bacillus from drinking water. There is one noticeable thing about the search for typhoid bacilli in water, and that is it is generally started when it is too late, and when there does not seem to be any necessity of sending samples to the bacteriologist for investigation. It would be a

good plan to at once send samples from small household filters for examination, and in that way try to reach back and get the bacteria which were in the water a week or two before.

Dr. Swarts.—I might mention my experience at Providence as a case in point. As medical inspector, I have to inspect every case of typhoid; and five years ago,—a period of especially great illness, an epidemic broke out. It occurred to me that these common household filters are good incubators, and I accordingly took it upon myself to seize these and take them to the laboratory of the Health Board. The height of the epidemic was not reached until fourteen days after that time. The river was infected, as typhoid discharges were thrown into it. The epidemic continued for about a week. By that time there were no typhoid bacilli in the water. The filters I thought might be of service in that way, and some were sent to Boston, and some to Dr. Prudden.

The question of the use of sand in isolating bacteria is an interesting one, and something can probably be done if we filter at the right time.

Dr. Prudden.—In regard to this matter I would say that only one of the filters which was sent to me showed the result of having been in action at the time that the water was infected. From the potato test and from a variety of other things, one culture showed perfectly the characteristics of the typhoid bacillus as they were then understood. Of course we can't know what is going to happen in science for the next ten years. I presume that if I had known that this convention was to meet here to-day, I should not perhaps at that time have considered the most prominent test for typhoid bacilli as emanating from the invisible growth on potatoes.

Chairman.—There is an impression, I think, among many people, and especially the boards of health, that the condemnation of water suspected of conveying typhoid germs should rest upon the actual demonstration of the typhoid bacillus. Such demonstration at present is not to be expected, and other considerations must determine the conclusion.

It has been stated that in the presence of the colon bacillus, the typhoid bacillus cannot be demonstrated in water after a day or two. The more recent evidence is in favor of a much longer survival of the typhoid bacillus in water than the earlier statements indicated. It has been found to live there three weeks and longer. The colon bacillus I do not think necessarily kills the typhoid bacillus. But the typhoid bacillus in water is not to be satisfactorily demonstrated by present methods.

Dr. Hewitt.—You have made reference to the boards of health, and given us a bit of information as to what they expect you to find in the observation of typhoid bacillus and other bacteria. For some twenty years now, I have served on a board of health, and I think that bacteriologists have themselves to blame for this misapprehension. It did not originate with the boards of health but with the experts themselves who make the analyses. The positive assertion—one of the subjects of

bacteriological congratulation—was made, that such diagnosis was possible. Simply send the suspected water to be analyzed and the diagnosis may be reached by bacteriologists.

Can't you, in this meeting, give us some positive information as to what we may expect in the way of positive diagnosis? If so, the expectation of health boards will be moderately accomplished. Those of us who have kept our feet on the ground, have been much interested in this matter. Samples of water have been sent to experts in the matter, and positive diagnoses have been returned. A sample of water from Lake Superior was returned with the information that it contained the bacillus of typhoid fever,—and this was done by a specialist, and he is a distinguished specialist, too.

What we want,—I say this without discourtesy,—what we ask of this convention, which has been now nearly a year in incubation, is not an impossibility, but such positive results as you gentlemen who are recognized as authorities, can give us. What can you tell us from water analyses, in the way of positive recognition of bacilli of disease,—of microbes of disease? That this field of bacteriology, in the state in which it rests at present, is a wholly satisfactory one is evidently not true, and while it is a bit discouraging it shows an activity and honesty which are highly creditable. But do let the boards of health understand the state of doubt in which you gentlemen are; let us have that at least to hold on to. The means of diagnosis of certain pathogenic bacteria is absolutely important. If it is impossible to recognize the bacillus of typhoid fever in water, why should there be such a great reservation on the subject? The aid from the bacteriologists in the differentiation of the diphtheria bacillus is most important, and no one has any doubt as to actinomycosis and organisms of some of our grosser diseases.

But do give us something positive,—one or two positive statements. Don't refer everything to a committee. Let those of you who are authorities on the matter come to some positive conclusion, and let us know it. Differentiate the known from the unknown in the same enthusiastic and honest way in which this convention has been conducted; but give us something positive.

Chairman.—I simply wish to say in reference to the ideas that Dr. Hewitt seems to have, that the impression in the minds of the members of this convention has always been, I believe, that Dr. Hewitt was one of the board of health men who was also a bacteriologist; and I do not think he can shove the blame entirely on the bacteriologists, inasmuch as he is himself somewhat of an authority on the subject.

As regards the question of referring all this matter to a committee, I cannot agree with him. I feel that the differences of opinion which have developed here among expert bacteriologists and the evidences of great difficulties to be overcome in dealing with this subject, should lead to the appointment of a committee of those present who have shown themselves to be most able to cope with such difficulties; and that time should be

given for the formulation of any definite results from this meeting. I think the resolutions of this committee will have very far-reaching results, not only in this country but in Europe. Its edicts and results will be very carefully criticised; and therefore I do not think we ought to attempt, by any snap judgment, to obtain definite results at present.

Prof. Sedgwick.—I unfortunately was late this morning; but from what I have heard since I came in, I should say that if any board of health has fallen into any slough in this matter, it is its own fault, because the first duty of every board of health is to keep in its employ a first class bacteriologist, who shall regularly devote himself to this line of work.

But I think we must admit frankly that Dr. Hewitt is right in asking from us, what I take it has already been given, namely, an acknowledgment that, so far as some pathogenic bacteria in water are concerned, we are unable to make the positive diagnosis which he wishes,—and he has stated that it is very much to our credit to acknowledge. It seems to me, if this were the only thing that boards of health in their history had had to take back water on, it would perhaps be well to make some discussion about it. But there are various things boards of health have had occasion to regret having done, and I don't see that this is any more important than some others. I think that boards of health and bacteriologists must of course be closely related, and I sympathize entirely with the difficulty of a man who has depended upon results which he afterwards finds to be untrustworthy; he is left in a bad predicament.

I have studied quite a number of epidemics, and the last thing I would solely rely on in such cases is bacteriological evidence. I try to use common sense, and so, I am sure, does Dr. Hewitt, though he has probably been misled by not keeping on tap in his office a good bacteriologist, who is not overburdened with other lines of duty.

Dr. Hewitt.—I beg to be permitted to close if there is no other speaker.

Dr. Lee.—While I think that what Dr. Hewitt has stated is true to a certain extent, of course at the same time it should be recognized that there has always been in the minds of the most able bacteriologists, a certain degree of uncertainty and a good deal of doubt and skepticism about the typhoid bacillus in water. Not this year nor last, but for several years, the difficulty of finding typhoid bacillus in water has been generally recognized. No one would be mean enough to infer that the work of the bacteriologists with reference to sanitary problems has not been of the first importance, as well in other directions as in the various problems relating to drinking water. I think, on the whole, it is a good thing that we are tending toward the solution of the great, broad problem of the purification of drinking waters, rather than of the diagnosis of one particular pathogenic organism in them.

I hope it is not ungracious to say that the bacteriologists are perfectly conscious that there is nothing in which so much worthless stuff is pub-

lished as in the bacteriological magazines; and it is not to be expected that those who are not familiar with the literature of the subject will be able to judge as to the value of the different works.

Dr. Hewitt.—I am sorry that it appears that our board of health has been negligent with regard to its relations to bacteriologists. I have the honor to be associated with bacteriologists in this, as well as in other matters. We have never lacked assistance when we wanted it. So far as using bacteriology in connection with our work there without the presence of a direct specialist,—the specialist being one, I am told, who is mostly in the air, and only in a remote connection with the man who plays the tune,—I would say that I believe that our loss has been a slight one.

But I am not making fun of this matter. I have as keen an appreciation of the value of a bacteriologist as anyone could have. I have seen and watched the work that is being done; but all I ask of bacteriologists, for the benefit of those who are working in our various laboratories, is that they should apply and define their work so that it shall be of practical use. Leaving the question of diagnosis of bacteria behind, I would say that I am especially interested in the work which is being done at the Lawrence laboratory. It is not a lesson on bacteria, so much as it is an attempt to discover the natural process of purifying water, and to learn how nature does the business; first they accomplished the work by natural means, and now they must find the process which nature is using. That is a point I want to know about, and is a thing that I am going to investigate before I return to Minnesota.

But isn't it possible for this meeting before it adjourns, to state exactly what bacteriologists can do with regard to actual, positive results? We have typhoid fever prevailing, and is there no means by which we can discover the cause of it in water?

Prof. Sedgwick.—I cannot let Dr. Hewitt's remarks go without explaining that I cast no imputation on the various state boards of health. I find that in our country the boards of health need every friend they can get. Dr. Hewitt and his corps are doing capital work in Minnesota. We must all pull together in the great work of public sanitation, if we would succeed.

(Dr. Adami takes the chair.)

Dr. Adami.—We will now listen to Dr. William H. Welch of Johns Hopkins University, Baltimore, on

WHAT SHALL BE THE MODE OF PROCEDURE IN DETERMINING THE PATHOGENESIS OF BACTERIA FOUND IN WATER?

Dr. Welch.—Of the diseases which are known to be conveyed by contaminated drinking water the most important are Asiatic cholera and typhoid fever. There is evidence that gastric and diarrhœal affections may also be caused by drinking waters, but we have no positive knowledge of the microörganisms which may be here concerned. Although the amœba dysenteriæ has not been demonstrated outside of the body, there is strong evidence that amœbic dysentery, and probable evidence that other forms of dysentery, may be caused by contaminated drinking water. There are some writers who strongly advocate the view that malaria may be conveyed by the drinking water, but positive proof of this view has not been furnished. The possibility of the conveyance of scarlet fever and diphtheria by water cannot be denied, but there is not much evidence in support of this opinion. Pyogenic bacteria, and various bacteria pathogenic to the lower animals, have been found in water.

Outside of cholera-infected localities typhoid fever is the disease most frequently suspected of conveyance through the agency of drinking water, and therefore the water problem oftenest presented to the bacteriologist is to determine whether or not the water in question contains, or is likely to contain, the typhoid bacillus.

By the work of Schottelius, Gruber, and Koch we now possess methods which offer a good prospect of isolating from water the cholera spirillum, should this organism be present, although this isolation has been rendered more difficult by the discovery of a large number of water vibrios which bear more or less resemblance to the cholera vibrio. The studies of R. Pfeiffer show that a most important differential criterion of the cholera spirillum is furnished by immunization of animals with this organism, so that we must recognize the animal test as an important factor in the identification of this microörganism.

We possess no equally satisfactory method for the determination of the presence of the typhoid bacillus in water. While we cannot say that the isolation of this bacillus from water by our present methods is altogether hopeless, nevertheless the difficulties are so great that there is a justifiable skepticism whether any of the reported isolations of this bacillus from drinking water rest upon the positive identification of the bacillus. With our present methods the most which can be expected from the biological examination of water as regards this question is the determination, not of the actual presence of the typhoid bacillus, but of the possibility or probability of its presence.

So far as this method of examining water is concerned, our principal guide at present in drawing conclusions as to the possible presence of the typhoid bacillus in suspected drinking water is the recognition of

fecal bacteria, and more particularly of members of the colon group of bacteria, which are the chief and most characteristic representatives of intestinal bacteria. By the work of Vincent, Peré, Wurtz, Matthews, T. Smith, Burri, and others we possess methods which enable us to isolate with much certainty from water the colon bacillus. For this purpose it is possible to submit to examination a litre or more of water. These improvements in technique have shown that the colon bacillus is a wide-spread organism in water, and in small number may be present even in the purest waters. The determination of the mere presence of this bacillus in water does not, therefore, suffice for the condemnation of the water. Attention must be paid to the number of colon bacilli present, and the determination of this point is not always easy. Moreover, where the decision rests upon quantitative rather than qualitative determination of bacteria, there must necessarily be opportunities for considerable differences of opinion even among experts.

Colon bacilli are distributed in external nature no less from the excrements of animals than from those of human beings, and although water seriously polluted with animal excrements is not fit for drinking, nevertheless we have no reason to suppose that typhoid bacilli are derived from animal excrements.

It is evident that the biological examination of water does not by itself alone at present suffice to solve the important sanitary problem here under consideration, although it affords valuable information. We must resort also to all the other methods at our disposal for the sanitary examination of sources of supply of drinking water, and not the least of these is the careful inspection for channels of contamination. Although these sources of contamination may be manifest to casual and untrained inspection, in general this inspection should be considered as no less a matter for expert study than the biological or the chemical examination of water.

Only one point regarding the identification of suspected typhoid and colon bacilli found in water properly belongs to my theme, and that is, whether the inoculation of animals affords us any help in this identification. These bacilli, as is well known, may manifest interesting pathogenic properties when inoculated into animals, but these are not so constant or of such a character as to enable us to rely upon them as valuable differential factors. Essentially similar results may be obtained by the inoculation of animals with virulent colon bacilli as with typhoid bacilli, as has been shown by the experiments of Blackstein and myself.

The question whether the immunization of animals with the colon bacillus, or with the typhoid bacillus, may assist us in the identification of these bacilli, and more particularly in the identification of the typhoid bacillus in the same way as it helps in the differentiation of the cholera spirillum, does not seem to me to have been as yet satisfactorily answered, notwithstanding a certain amount of work upon it. The results have been conflicting, but it is not improbable that we may find

in this procedure a valuable differential criterion for the typhoid bacillus. The procedure would be, on the one hand, the immunization of rabbits or guinea pigs or mice with culture products of an undoubted typhoid bacillus, and the subsequent determination of the presence or absence of immunity from the suspected typhoid bacillus; and, on the other hand, the immunization of the animals with cultures or products of the suspected bacillus and their subsequent inoculation with undoubted virulent typhoid cultures or their products. A number of preliminary problems must, however, be solved before we can determine the value of this immunizing test.

Although the cholera spirillum and the typhoid bacillus claim the first place among the pathogenic bacteria which may be found in water, these are not all of the disease-producing bacteria which may be present. Mention has already been made of the occasional presence of pyogenic staphylococci and streptococci. The bacillus proteus and the bacillus pyocyaneus are not without some pathogenic significance, and they have been detected in water. Of the bacteria pathogenic to animals there are several which must find opportunity to gain access to water. Mention may be made especially of the anthrax bacillus, the hog cholera, and the chicken cholera bacillus. As is well known, a number of pathogenic bacteria, chiefly of interest to us in our laboratory experiments, have been isolated from water, usually, however, from water which no one would think of drinking.

Although pathogenic bacteria in general do not multiply in drinking water, and frequently quickly die out, still they may survive in certain drinking waters a long time. The opinion that cholera and typhoid bacteria cannot survive in drinking water more than a few days has been shown to be incorrect. They may live a month, or even longer, in some unsterilized drinking waters.

Our search for pathogenic bacteria in water is much facilitated by the fact that bacteria pathogenic for warm-blooded animals, if capable of development in our artificial cultures, will grow at the temperature of the incubator. By cultivating at 36° or 37° C. we are enabled to eliminate a large number of the ordinary water saprophytes. There are, however, bacteria pathogenic for frogs and other cold-blooded animals which do not grow at these high temperatures.

In attempting the isolation of particular species of pathogenic bacteria we can sometimes use to advantage elective culture media, a procedure which is likely to be improved and still further elaborated by subsequent research.

In testing as to the presence of pathogenic or toxic germs in water, it seems to me to require no argument at the present day and before this convention that such tests should be made with pure cultures of the isolated bacteria, or if for any reason it is desired to determine the effects of inoculation of mixed cultures, this should be done with precise knowledge of the bacteria concerned, a knowledge which can be gained only by

the isolation in pure culture of the individual species. The adoption of such procedures as the inoculation of animals with impure bouillon cultures obtained simply by the addition of the water to bouillon is contrary to the accepted canons of modern bacteriology and does not afford information which is clear in its interpretation.

I should like to see the test of pathogenesis adopted as a routine procedure in the determination of the characters of all species of bacteria, and I would even go so far as to suggest the inoculation of frogs or other cold-blooded animals in the case of bacteria which grow only at ordinary temperatures. Our blank forms for inserting the descriptions of bacterial species contain the word "pathogenesis" as one heading, and the space belonging to this caption should not be left blank when we record the differential characters of a species.

It is true that virulence is one of the most variable of the characters of bacteria, and that cultures of pathogenic species isolated from external sources are particularly prone to be of little or no virulence. These facts, however, do not justify us in dispensing with the test of virulence in our studies of bacteria from water and other sources. The determination of loss of virulence under various conditions is in itself an interesting and important fact.

In testing bacteria isolated from water for pathogenic properties I do not know that there are any technical points concerned different from those applicable to bacteria from other sources. Inasmuch as it is the purpose of this convention to establish so far as practicable certain standards of bacteriological procedure, especially in the line of greater precision, it will be appropriate to speak of certain points in the technique of testing for pathogenic properties.

It is important to distinguish between actual infection and intoxication resulting from the inoculation of bacteria, although this distinction is by no means always easy, as is apparent from the controversies as to whether inoculation with the typhoid bacillus, the colon bacillus, or the cholera spirillum causes death by infection or by pure intoxication without multiplication of the inoculated bacteria. These controversies have been settled in favor of the view, that according to varying conditions each of these species may produce either infection or simple intoxication. Where large doses of cultures are required to produce symptoms or to cause death, there should be suspicion of pure intoxication, and especial attention should be given to the distribution of the bacteria in the animal body and to evidences of multiplication of the bacteria in the living animal. It is of course understood that even in infections bacteria do injury through their toxic products.

We are too much in the habit of considering the death of the animal following inoculation as the sole test of pathogenesis. Animals, as well as human beings, may recover from disease, even severe forms of disease, and it is well to examine carefully for evidences of pathogenic effects which may not prove fatal. The use of the clinical thermometer

is an aid in this examination, but the observer should be familiar with the limits of physiological variation in the temperature of the animal concerned and of various causes, such as excitement, struggling, immobilization of the animal, which influence the temperature. Cultures can be made from the blood and other parts of the living animal. I have been much interested in the study of a non-fatal peritonitis in the mouse produced by a pseudo-tuberculosis bacillus. It was possible by inserting the needle of a sterilized hypodermic syringe into the scrotum to withdraw exudate from the peritoneal cavity and to examine this bacteriologically and microscopically. Notwithstanding the production of so large an amount of exudate as to greatly distend the abdomen and scrotum, and notwithstanding the demonstration of very great multiplication of the specific bacillus in the peritoneal cavity the animal recovered completely. I have also had opportunity to study a similar form of non-fatal pleurisy in the animal.

The general rule, as regards the selection of cultures to be tested for virulence, is to use either bouillon or agar cultures which have developed for forty-eight hours in the thermostat. Dosage can be more accurately expressed when bouillon cultures are used, and in general these are to be preferred. The use of forty-eight hour bouillon cultures has been the recognized rule in testing the diphtheria bacillus for its virulence. Nevertheless I have found with this bacillus, as well as with others, that inoculation with forty-eight hour agar cultures may give positive results when the bouillon cultures fail. It is sometimes useful, especially when the growth in bouillon cultures is not abundant, to reinforce the bouillon culture with the growth on an agar tube at the time of inoculation. The solid growth on an agar culture can be inserted into the animal with the platinum loop, or a suspension of this growth can be made in a small quantity of physiological salt solution or bouillon and the inoculation made with a syringe. The turbid fluid at the bottom of an agar culture, perhaps reinforced by mixture with some of the solid growth, is often good material to select for inoculation with a syringe or platinum loop. There are of course circumstances where it is desirable to use fresher or older cultures than those specified. When it is desired to determine the presence of toxic substances in the cultures, of course older cultures will be used, the general rule being the selection of bouillon cultures three weeks old grown in the thermostat. When the bacteria are to be eliminated, the filtrate from a Pasteur or similar filter will be used.

Where fluid cultures are used dosage can be most accurately expressed in percentage of the weight of the animal. In all cases the weight of rabbits and guinea pigs used for the experiment should be stated. In general young animals are more susceptible than old animals to even proportionately the same doses of bacteria. The dosage of cultures on solid media cannot be so accurately expressed as that from liquid cultures. By the use of the same platinum loop, fairly satisfactory results as regards dosage can be obtained in the hands of one and the same

observer, as has been shown by the studies on this point of R. Pfeiffer in inoculations of agar cultures of the cholera spirillum. Where liquid cultures or suspensions of solid cultures are used a fairly accurate idea of the number of bacteria inoculated can be obtained by counting the bacteria in a known quantity of the fluid. Nuttall's method gives particularly precise results on this point. This somewhat laborious procedure will not, however, be likely to be adopted except for certain special purposes. Plate cultures also can be used to determine the number of living bacteria present in a known quantity of the fluid used for injection.

It should be noted at the time of inoculation whether any of the material inoculated escapes from the wound, and, so far as possible, allowance should be made for this.

No rules of general application can be laid down as regards the amount of culture to be injected. Perhaps from one half to one per cent. of the body weight in the case of fluid cultures, and one or two good sized platinum loops from solid cultures, will represent the usual doses with which the first test of the possible virulence of a culture will be made. Positive results with these large doses should be followed by the inoculation of smaller quantities.

It is desirable to test the possible virulence of the cultures upon each of the three species of animals—mice, guinea-pigs, and rabbits—ordinarily used for this purpose in our laboratories. These animals differ in susceptibility to different species of pathogenic bacteria. If only one animal is used, it is best to select the mouse, as being in general, although by no means always, the most susceptible. Either white mice or the ordinary house mouse may be used. I have not observed any special differences of susceptibility between these two varieties.

The simplest and most common procedure is subcutaneous inoculation, but inoculation into the peritoneal cavity or directly into the circulation, is often (not invariably) a more severe test. For the technique of injection into the ear-veins of rabbits, I would refer especially to the description of this procedure given by Abbott in his "Principles of Bacteriology."

Where a single test of the virulence of a culture is to be made, the most severe is in general direct injection of the culture into the peritoneal cavity of a mouse. When this fails after a good dose (say 0.1 to 0.3 cc.), it is not likely that other methods will be successful in causing the death of the animal, although it may be interesting to observe the local effects of subcutaneous or cutaneous inoculation.

The inoculated animal should be kept under observation weeks and sometimes even months after it has appeared to survive the effects of the inoculation. Experience with the hog cholera bacillus, the typhoid bacillus, the colon bacillus, and even with the lanceolate micrococcus, has shown that death may occur so late that the animal may have been dismissed from further observation. Inoculated animals, if put back into the cage with others, may be marked in some way to distinguish them. In general it is best not to use animals which have survived

inoculation for further tests of pathogenesis of bacteria. We cannot control, without special study, the influence which a previous inoculation may have had upon the susceptibility of the animal to the same specie or to other species of bacteria.

As regards the choice of syringe to be used in inoculating animals, this is a matter which will be determined largely by personal choice, based upon experience with one or another variety. My own preference is for the ordinary hypodermic syringe. It can be readily obtained, and cheap forms can be used. I find no difficulty in sterilizing these syringes by filling them with five per cent. carbolic acid, allowing them to remain thus filled for half an hour or more and then washing them out thoroughly five or six times with sterilized water, salt solution, bouillon, or other sterile indifferent fluid. When filled with the carbolic acid the barrel of the syringe fits loosely in the mouth of a bottle filled with carbolic acid, into which the needle dips.

The platinum needle or loop used for subcutaneous inoculations should be of tolerably thick wire, so that the needle is stiff enough to push into the subcutaneous tissue without bending.

I see no object in attempting to sterilize the skin over the seat of inoculation. Such attempts are futile, unless an eschar is produced by thorough burning. It suffices simply to cut the hair close over the site of inoculation. An incision is then to be made with sterilized scissors or scalpel into the subcutaneous tissue. The beginner is likely to fail to cut as deeply as the subcutaneous tissue, and encounters a great obstacle in attempting to force the needle into the dense cutis.

Upon the death of the animal the seat of inoculation, if subcutaneous, should first be exposed and carefully examined bacteriologically and microscopically.

In making the post mortem examination it seems to me unnecessary to resort to any elaborate antiseptic precautions in exposing the different viscera, unless especial attention is to be paid to cultures from the serous cavities. The skin need not be, in fact cannot be readily, sterilized, and it suffices to lay the hairs by simple wetting with water over and around the line of incision through the skin. This incision need not necessarily be made with sterilized instruments, or the scalpel and scissors may be slightly flamed. It requires far less heating in the flame of a Bunsen burner than is generally employed to sterilize metal instruments. The heat need not be so great as to seriously damage the steel. Incisions through the skin approximately at right angles to the long median incision and extending along the extremities very much facilitate the disposition of the flaps, which can thus be kept out of the way of the subsequent examination, without resorting to pins or other devices.

Cultures should be made at once after opening the animal. It is important to determine the distribution of the bacteria in the blood and various organs, and as a matter of routine procedure it is well to make cultures from the peritoneal cavity, spleen, liver, kidneys, lungs, and

heart's blood. Especial care will of course be taken to obtain cultures from any apparent local focus of disease. My custom is, after opening the peritoneal cavity and before removal of the sternum, to make cultures first from the peritoneal cavity, then from the spleen, the liver, and the kidneys. The sternum is then removed and cultures made, if need be, from the pleural cavity, then from the lungs and the heart's blood. I consider it important to burn thoroughly the surface of each viscus with a red hot scalpel or other metal, at the site where the needle is thrust in to obtain the material for inoculation. This precaution renders unnecessary the elaborate preliminary steps to secure a sterile field, which have sometimes been recommended. It destroys microörganisms which may have entered accidentally from the air, or by contact, and it eliminates from the culture the bacteria which may simply be present on the serous covering of the organs, and not present in the substance of the organ. As by this thorough sterilization of the surface bacteria may be killed to a certain depth, the platinum needle should be thrust well into the substance of the organ, and this is facilitated if a small incision is first made with a hot scalpel through the scorched area on the surface.

The amount of material to be used for inoculating the culture tubes will vary with the number of bacteria likely to be present in the material. These may be so abundant that the insertion of a straight needle brings away enough, or a loop may be used to secure a larger quantity, or it may be necessary to remove a bit of tissue with a sterilized instrument. Especially constructed platinum scoops or spears and other devices may be left to the ingenuity of each experimenter, where large amounts of material are to be secured, or other purposes, such as ease of penetration into a dense organ, are to be subserved by their use.

When it is desired simply to recover in pure culture from the organs of the inoculated animal the species of bacterium inoculated, simple stab, line, or smear cultures will suffice, but the correct procedure for determining approximately the number of bacteria in different situations, and for insuring, according to Koch's principles, pure cultures from single colonies, is, of course, to make plate or roll cultures. As a rule these will be agar cultures in Petri's dishes.

After the culture tubes have been inoculated and labelled, the microscopical examination by cover-glass preparations is to be made of the blood and other fluids and of the organs. This should never be neglected. It affords information as to the number and distribution of the bacteria, their arrangement, the presence or absence of capsules, their morphology in the animal body, and their staining reactions in this situation.

Sections can at once be made of the organs with the freezing microtome, and these are most useful in determining the existence of fatty and other degenerations, which often escape observation in the study of sections of the hardened tissues. These sections can be used also for staining the bacteria in the tissues, but not much is to be gained by this,

as better results are obtained in staining the bacteria in the hardened organs.

Alcohol is the most useful hardening agent. The meagre and unsatisfactory descriptions of the histological lesions furnished by bacteriologists in general is much to be regretted, but this, perhaps, cannot always be otherwise, as bacteriologists are not always pathologists. Very considerable interest attaches to the pathological study of our experimental infections, and I would suggest that especial attention be paid to the careful histological examination of the organs and tissues in our experimental infections. Matters of interest in themselves, and sometimes of diagnostic value in determining species, will thus be brought to light.

If the culture proves to be of only slight virulence, the attempt may be made to increase the virulence by successive passages through the animal body. Sometimes this is best accomplished by inoculation directly from animal to animal, and sometimes by inoculation of fresh cultures from the animal body.

Dr. Adami.—In discussing this matter of procedure in the determination of the pathogenesis of bacteria there are two points not touched upon by Dr. Welch in his very clear presentation of the subject, as to which I should personally be glad to gain his opinion. The first of these is the advisability of periodic determination of the temperature of the inoculated animals, taken *per rectum*. Does he consider that this should be recommended as a matter of routine? The second is the time during which the inoculated animals should be kept under observation. I am inclined to consider that there is altogether too great a tendency to shorten the time to a matter of a few days, or at most, less than a fortnight, and it would, I think, be well if Dr. Welch would suggest some regulation in this connection.

Here, perhaps, while dealing with this subject the matter of syringes may well be discussed, the forms which have been found most satisfactory, and the methods of rendering them aseptic.

The paper is open for discussion.

Dr. Abbott.—As to the syringe,—I prefer the ordinary hypodermic syringe, so constructed that it can be sterilized by either thermal or chemical means, without sustaining injury.

My reason for this preference is that one has more control over the fluid to be injected when one forces it from the barrel of the syringe by means of an accurately fitting piston-head than when it is propelled by an elastic air cushion, as in the Koch ball syringe, for example. In the injections the point of the needle encounters more or less resistance, and if the propelling pressure be increased sufficiently to suddenly overcome this resistance the air cushion, in the case of the ball syringe, is brought under such tension that when the fluid is finally ejected it leaves the syringe with a rush, and, as is often the case, a larger dose is injected into the animal than had been intended.

Another undesirable result from the employment of the air cushion

syringe, is that frequently seen upon the withdrawal of the needle from the tissues of the animal, viz., the removal of the point of the needle from the resistant tissues allows of expansion of the compressed air cushion, and the consequent further escape of a few drops of fluid from the instrument. I have not had these unsatisfactory results with the ordinary piston syringe, with which I believe the dosage can be more easily and accurately controlled.

DR. WELCH.—It is generally agreed that the dosage of fluid inoculations is best expressed in percentages of the weight of the animal; but we are also to remember that animals of different ages and weight vary in susceptibility. A large animal is more resistant to the dose, in proportion to its weight. The small animal is simply more susceptible. The question in my mind is whether it is not desirable to select animals of weight within certain limits, not only for diphtheria, but for other things.

DR. ABBOTT.—With regard to the taking of rectal temperatures in small animals, my own experience has led me to conclude that but little of importance is learned by this manipulation, unless the fluctuations are extreme in one or the other direction. With such animals as normal Guinea pigs and rabbits, for instance, the diurnal fluctuations, as well as the frequently observed fluctuations during manipulation, as revealed by this method of examination, are often so great as to render them valueless as indicators of the inception of pathological processes. I have latterly ceased to keep the record of daily range of temperature, and rely more on diurnal variations in the body weight, the animals, of course, receiving nearly a constant weight of food each day.

DR. WELCH.—In regard to the thermometer, Mr. Chairman, I agree with you that it is worth while to take the temperature in the rectum. My experience has been almost entirely with rabbits. The temperature of the rabbit varies within a very wide limit,—from 101° to 104° F. It makes a great difference, also, whether the animal struggles or not in taking the temperature. It is well known that a rabbit's temperature falls when it is fastened down for any length of time, and it is also desirable to have a record of the normal run of the animal's temperature.

The importance of keeping inoculated animals a long time under observation is illustrated by our experiment with the inoculation of rabbits with the colon bacillus, and the typhoid bacillus. After the experiment was supposed to be over they were marked with various colors to identify them. I found that they died sometimes as long as four or five months after inoculation. The colon bacillus and the typhoid bacillus are able to stay almost indefinitely in the bile of the animal, and may produce eventually the death of the animal, in one instance nearly a year after inoculation. This is an extreme case. The longest period is usually four months. The hog cholera bacillus sometimes will cause the death of the animal after a month or six weeks, particularly of the

mouse. In all cases animals should be marked so as to identify them in the future.

As regards the syringe, I think that is a point which every one makes up his mind about from experience.

(Dr. Welch takes the chair again.)

PROF. SEDGWICK.—I have a suggestion to make which may be apart from the question itself, but which seems to me to be closely akin to it, and that is that I want to say a word to the members of the convention with regard to vivisection. It is easy to say that we shall not have any trouble in this way, etc. But they have had a great deal of trouble over it in Europe, and the society in this country has had a great deal to say on the subject. Our people are a good deal like other people after all; and it seems to me that every one should know exactly what he is going to do. We have to be prepared, I think, for more or less opposition; and there is no department of biology in which the field is more clearly justifiable than in bacteriology,—none where the intention is more obvious. This was brought to my mind by an attack made by a person whom you all know, in the public press, alleging that in determining the pathogenesis of bacteria undue suffering was caused.

CHAIRMAN.—Our next number is the paper of Professor Adami, on "How is Variability of Species to be Regarded?"

(Dr. Adami's paper. See page 415.)

CHAIRMAN.—Professor Adami's paper is now open for discussion. There is not much which can be added to what Dr. Adami has said. It seems to me important to bear in mind three points:—first, that the observed modifications in the characters of bacteria are produced, for the most part, by changes in their environment, these changes being generally of an unfavorable nature; second, that these modifications of character usually disappear shortly after a return to a favorable or natural environment of the organism; and third, that the modifications relate almost wholly to changes in function or physiological characters, and not to changes in form, if we exclude the so-called degeneration forms, which are mostly pathological. Permanent variations in function, such as of virulence, power of producing spores, of liquefying gelatine, of producing fermentations, colors, etc., can be produced, but the variations in morphology are not generally permanent when it is possible to restore the natural, most favorable environment of the organism. We are obliged, with our present imperfect classification of bacteria, to recognize these physiological modifications of character as establishing new varieties and races; but if we could be guided in our classification of bacteria by the same principles as in the classification of the higher plants and animals, we should probably attach less significance, in a broad biological sense, to these physiological variations than we are at present obliged to do. Bacteria are not known to be subject to sexual

variations, and for this reason it may be that the ancestral characters are better retained than if they were subject to variations resulting from sex.

Dr. Moore.—I would like to call attention to an article by Perego, on the flagella varying according to the conditions of temperature. He finds in the colon bacillus for example, that a certain number of flagella could be demonstrated when this organism is under ordinary cultivation; cultivated at the maximum temperature he could not find flagella at all; and when cultivated at a temperature of 40 degrees, a very few.

Dr. Adami.—Referring to Dr. Welch's remark concerning the part played by sex in inducing variation, I would wish to urge that, on the other hand, it is the absence of sex and sexual union in the bacteria which is one of the main factors tending towards increased liability to variation, or more truly to perpetuation of variations. Sexual reproduction, in fact, among the higher animals (though this is a point which is not generally appreciated) is to a far greater extent a means of preserving the mean than of causing departure from that mean.

Dr. Kinyoun.—In relation to studying variations of bacteriological cultures I think that one point which has not been mentioned, should be taken into consideration, that is, that in preparing stock cultures, it has been the recognized practice to take from only one colony of a bacterium. This is misleading in many microörganisms. I think that there should always be several colonies taken from a plate in making our stock culture. This is requisite when a bouillon culture is made to test the pathogenesis. Variations both in reaction and pathogenesis have been observed by myself and others in diphtheria and typhoid bacilli. Colonies of diphtheria bacilli—alike in all appearances, may differ materially in their virulence, this may be noticed even in cultures made from a single colony. Typhoid bacilli show this in their reaction to milk, giving a deep blue color in litmus milk in some instances, whereas the common reaction is a slight purple.

Dr. Prudden.—One observer in our laboratory who has taken the trouble to plant from thirty different colonies of the same kind, and from one plate, has had most interesting results with regard to this point.

Chairman.—Are there any further remarks on this subject? If not we will take up the last question on our list. The paper is by J. J. Mackensie, on: "What New Methods can be suggested for the Separation of Bacteria into Groups and for the Identification of Species?"

(Mr. Mackensie's paper. See page 419.)

Chairman.—Mr. Mackensie's communication is now open for discussion. There are some very important points in it, especially as regards the use of synthesized media. I presume that a good many of the members don't know anything about this subject,—or didn't until he read his paper, and it is a particularly interesting thing. We ought to congratulate ourselves on having an opportunity to see these things, and having the subject so carefully studied up. Are the media easy to make?

Mr. Mackensie.—Very easy. Ammonia salt is used, and solution.

Chairman.—Dr. Moore, did you incorporate what you wished to say about flagella? Although your paper is not on the programme, we shall all be interested to hear it.

(Dr. Moore's paper was then read. See page 432.)

Dr. Cheesman.—In regard to what Dr. Moore says, I will state that I have used Loeffler's second method, with slight modifications in preparing the immersing fluid, and the preparation gives much better, more constant, and definite results; but I must confess that I have not given Bunge's method a good trial. We have not had fair results with this method, I think, but very good with Koch's.

Chairman.—Are there any further remarks on this subject?

This completes the list of subjects. I see that it is announced on the programme that we should have communications from various other sources. We have heard from Dr. Russell and Dr. Shuttleworth. Have any of the other gentlemen any communications to make?

If not I will announce the names of the committee after Dr. Prudden has made a motion.

Dr. Prudden.—I think that it is evident to all of us that the success of the convention will depend on the decisions of the committee; and as I understand it, this committee was to consist of five members. Would it not be better if we have a few more? I move that this committee consist of eight, and of this eight the chairman should be ex-officio member.

Chairman.—I have been extremely embarrassed in reducing the number of this committee to five, and it is embarrassing enough to make a selection of eight; so I think it would be better if that motion were carried. Any remarks on this motion?

Motion was seconded and carried.

Chairman.—I have selected as members of the committee, Doctors Adami, Sedgwick, Fuller, Smart, Abbott, Cheesman, Smith, and Welch.

As I understand it, the work of the committee will be the consideration of all the communications which have been presented here. Some member will put a resumé of the work in suitable form for publication in some journal, to bring before the public the general results of the convention here, as a record of our proceedings; others will devote attention to the formulation of answers to these various questions,—it is clear that a considerable amount of decisiveness has been shown upon some points, while others are still too indefinite; but I think it is to be expected that this committee may be able to make some very positive statements of real value to workers in bacteriology. That I understand to be the general scope of the work of the committee. If the members of the convention have any suggestions to make that would be helpful to the committee, we shall be very glad to hear them expressed.

Dr. Swarts.—I do not know to what extent the committee ought to extend the scope of this work. Will it rest upon them to determine

the lines for the workings of the various laboratories? Originally, in Montreal, the object of the American Public Health Association was to have various laboratories throughout the country working in conjunction, experimenting upon various subjects of importance, and communicating the results to each other, in order to evolve some definite expression of standard results. And we have got that expression. Much of it is the result of work,—systematic work; but much of it is simply the expression of the opinion of the person, without any work,—and that the committee should take up the consideration of all this, seems very unnecessary.

Prof. Conn.—I would like to ask the Chairman whether the report of this committee is to be published, or whether a report is to be made to another Association, or how it is to be promulgated; whether in the medical journals or how the report is to be made?

Chairman.—My understanding is that the decision yesterday was that the committee is to report to a committee of the American Public Health Association. I think the work of our committee will have relation to the American Public Health Association; but it will carry independent weight also. Its work can be published as the work of the committee, authorized by the convention; but the official report will go to the American Public Health Association.

Dr. Swarts.—I would like to ask if this is to be the last meeting, or whether we are to meet again?

Chairman.—I think the better way of disposing of this is to follow Dr. Smart's suggestion of letting a few come together to consider the matter at a later time.

Dr. Swarts.—I understand that the whole proceedings, including the papers, are not to be lost.

Dr. Welch.—The report of the committee goes to the American Public Health Association. The papers will probably appear, so far as they are ready for publication, in the various journals; and there will probably be published a summary of others which have been more or less ex tempore.

Dr. Kinyoun.—The American Public Health Association has called a committee of bacteriologists to consider only one subject,—that is the bacteria found in water supplies. To this end a committee has just been appointed which will deal with this question and a great many other questions of prime importance to the workers in bacteriology entirely outside the question of water supplies. The American Public Health Association, as I understand by the letters of the committee, does not want anything except a systematic research on the bacteria of water. It seems to me that the work of this committee is so broad and comprehensive and important that it should not be lost; there will, also, in the future, come up from time to time a great many of the questions which cannot be settled as easily as dealing with water supplies. It should be continued under the auspices of an independent association.

Dr. Lee.—Inasmuch as this convention was called by Dr. Smart, as

chairman of the committee on water supply of the American Public Health Association, I think that it would be well, perhaps, to ask his opinion as to what future course shall be taken.

Dr. Smart.—I think that the committee of the convention should report to the water committee of the American Public Health Association. I think there has been a general understanding that it would so report. As chairman of the latter committee I shall endeavor to have the proceedings of this convention published.

Chairman.—I think it should be clear that the questions concerned are of rather limited scope, just as the work of this convention has been. They relate largely to the solution of the problem of water supply, particularly to questions of technique and method, rather than to results.

It seems to me that the convention has been a success,—that the interest which has been shown in it by the large attendance, and by the presence of so many members from a distance, has been most encouraging, and clearly points to the formation of some society in the future which shall bring together the working bacteriologists, and which shall be the means of the continuation of the work here begun. I believe that we are prepared to make some actual contributions to bacteriological science as the result of the meeting here. I think that we ought to thank the committee who are responsible for the inception of this movement.

Dr. Prudden.—Before we adjourn let me speak for the members of the convention, as well as myself, in expressing our great indebtedness to the chairman for his skill and kindliness in conducting these meetings.

Dr. Smart.—Gentlemen, on behalf of the American Public Health Association, I would like to say a few words of thanks before this meeting adjourns. I want to thank the Academy of Medicine for its hospitality in offering us this pleasant place for our meetings. I want to express my thanks to Professor Cheesman of the College of Physicians and Surgeons, and Dr. Ferguson of the New York Hospital, who have acted in the capacity of a local committee of arrangements. Then again, I wish to thank Professor Welch for his special work as chairman of the convention; and lastly, I thank the whole of the membership of the convention for the interest which they have taken in the work.

Motion of adjournment was made, seconded and carried.

REPORT OF COMMITTEE ON NOMENCLATURE AND FORMS OF STATISTICS.

To the President and Members of the Association:

The committee on Nomenclature and Forms of Statistics respectfully presents the following report:

The following topics have been considered by the committee:

1. Changes in the nomenclature and classification of diseases, and causes of death.
2. Uniform methods of reporting vital statistics.
3. Uniform methods of estimating populations and death-rates.
4. Adoption of a standard age distribution.

1. NOMENCLATURE AND CLASSIFICATION.

The importance of a uniform and definite system of nomenclature and classification of diseases and causes of death, to the general practitioner, the pathologist, the clinical teacher, to boards of health (local and general), and to registrars, must be acknowledged. Such a system is not, like a system of weights and measures (the metric system, for example), capable of adoption for all time. On the contrary, a system of nomenclature and classification requires occasional revision in order to be in harmony with the progress of medical science.

At the same time the importance of the subject is such, especially to public hygienists (to whom vital statistics are the ground-work and basis of effective work), that no hasty action should be taken in this direction; and, when definite action is taken, it should be with the common consent of medical men generally. Hence your committee recommends that this Association, through this committee, bring the matter to the attention of the principal medical organizations throughout the country, including the American Medical Association, the Mexican Medical Association, the Canadian Medical Association, the faculties of the principal medical colleges, the state boards of health and boards of health of the large cities, the medical departments of the United States army, United States navy, and Marine Hospital service, with the view of securing definite and harmonious action.

NOTE.—As an important and valuable contribution to this subject, your committee has decided to append to this report a translation of such parts of Dr. Bertillon's Report to the International Statistical Institute, at Chicago, in 1893, as appear to be of especial interest to public health officials, and to persons generally interested in the subject of nomenclature of diseases and causes of death.

2. UNIFORM METHODS OF REPORTING VITAL STATISTICS BY BOARDS OF HEALTH.

Upon this subject, your committee respectfully requests further time for making its report.

3. UNIFORM METHODS OF ESTIMATING POPULATIONS, AND DEATH-RATES.

All mortality-rates must depend for their accuracy upon the number of the population, and the number of deaths. Assuming the latter to be definitely ascertained, the former is only known with accuracy by means of a census enumeration. This is usually taken at stated intervals of five or ten years. For the intervening years, some definite method of estimating the population of nations, states, counties, districts, cities, and towns, should be agreed upon. Unfortunately, diverse and unsatisfactory methods prevail with different authorities. In some places it is assumed that the population bears a definite ratio to the assessed polls; in others, to the number of school children; in others still, the number of names in the city directory is taken as a standard. The general tendency of many city authorities is to exaggerate existing numbers. Hence, the desirability of agreeing upon a uniform plan is very evident.

In most countries having registration, and also in some states and cities of the United States, it is now the custom to estimate the population of intercensal years, upon the basis of the rate of increase (reckoned geometrically) which prevailed during the previous intercensal period. While no arbitrary or conventional method can yield results which are perfectly satisfactory, especially when applied to the populations of American communities, which present greater fluctuations in rates of increase than those of most transatlantic countries, still, we believe that the most reasonable method, and that which in the long run will prove the most accurate, is the geometric rate of increase.

Dr. Farr, whose intelligence and foresight no one can question, proposed this plan for the English registration reports and it has been followed since his day to the present time.

In a paper by Mr. Noel A. Humphreys upon the "Estimates of the Population of the Largest English Towns" based upon the English census of 1881, he states that the average error in the estimates based upon this method was but 6.4 per cent. for the twenty-eight large towns of England, and this result was attained where the census is taken but once in ten years. A five-year census would very largely diminish this source of error. Some of our states already have a five-year census, and it is desirable that the members of this Association should urge upon their state authorities the importance of establishing an intermediate five-year census, half way between the periods at which the national census is taken.

In concluding this portion of the report, we would call attention to

Mr. Humphrey's concluding statement upon the value of the death-rate.

"In spite of misuse by the ignorant, and abuse by the interested, the power of the death-rate as a prime factor in health progress has hitherto constantly increased, and cannot be spared.

"The well-nigh insurmountable difficulties in the way of even approximately estimating the population of towns during ten-year periods must, however, seriously discount the public faith in mortality statistics, and a quinquennial census appears to be the only sure means for sustaining the credit and influence of death-rates, the failure of which would dangerously hinder and imperil the cause of sanitation."

4. STANDARDS OF AGE-DISTRIBUTION.

It is quite plain that a fair comparison cannot be made of the death-rates of countries, cities, and towns in which the age distribution is widely different. Other things being equal, a city in which the persons living under one year of age, and those who are more than fifty years of age, constitute together more than fifteen per cent. of the population, will have a higher death rate than another city under similar conditions in which the persons of these ages constitute less than ten per cent. of the total population, since the death rate at these age periods is invariably much higher than that of the remaining population, constituted as it is of children who have passed the first and most critical year of infancy, together with the vigorous population of early adult life.

Hence the importance of adopting some conventional standard to which all populations may be referred, or with which they may be compared.

For example, in the comparatively new populations of such states or territories as Arizona, Nevada, Idaho, and the older state of Iowa, the ratios of persons of the two age periods, 0-1, and all over 50, were as follows, by the census of 1880:

Per cent. of Persons Under One Year and Over Fifty Years to the Total Population.

Arizona	8.90 per cent.
Idaho	12.64 " "
Nevada	10.52 " "
Iowa	13.99 " "

On the other hand, the per cent. of persons living at these age periods in the two older states of Delaware and Vermont was as follows:

Delaware	15.92 per cent.
Vermont	21.85 " "

Now since the death-rate of children under one year is usually from eight to ten times as great as that of the total population, and that of

persons over fifty is usually not far from twice as large, it follows that, other things being equal, we shall expect to find a general death-rate in these older states correspondingly greater than that of the newer communities.

For the purpose of finding an adequate remedy for this condition, your committee has examined the different methods which have been proposed, those of Dr. Ogle,[1] of Bertillon, and of Körösi, as well as the excellent explanation afforded by Dr. Newsholme, and conclude that the method recommended by Körösi of Budapesth is the most simple, the least cumbrous, and is also sufficiently accurate for the purpose for which it is designed. His method comprises a division into four age-groups, as follows:

0-1 year.
1-20 years.
20-50 years.
All over 50 years.

He also recommends that the age-distribution of only one country, for example, that of Sweden, be employed as a standard. The distribution of Sweden by its census of 1880 was as follows:

Age-periods.	Per cent.
0-1	2.65
1-20	39.81
20-50	38.62
All over 50	18.92
	100.00

The method of application is as follows, as applied to a single state:

Age-Groups.	Standard Distribution Sweden, 1880.	Death-rate, Massachusetts, 1880.	Mortality Index.
0–1	2.65 per cent.	19.13 per cent.	5.07
1–20	39.81 "	1.28 "	5.09
20–50	38.62 "	1.03 "	3.98
All over 50	18.92 "	3.90 "	7.38
	100.00	....	21.52

In intimate connection with this subject your committee takes pleasure in announcing that the state registrar of Maine has recently issued his first annual report of the vital statistics of that state, thus completing the registration of the six New England states, and it is the intention of the secretaries of the state boards of health of these states to issue

[1] Dr. Ogle's division is one of twelve groups, and hence increases the labor of computation threefold.

shortly a combined summary of the vital statistics of New England, with the hope of thus advancing the cause of registration throughout the Union, and of stimulating delinquent states to the necessity of legislation for the purpose of rendering registration everywhere compulsory.

In closing, your committee respectfully suggests that its scope may be enlarged, so as to embrace the whole subject of vital statistics.

SAM'L W. ABBOTT,
CHARLES A. LINDSLEY,
CHARLES N. HEWITT,
E. PELLETIER,
J. E. MONJARAS,
Committee.

Your committee has deemed it advisable to publish the following abstract of Dr. Bertillon's report, which was presented at the session of the International Statistical Institute at Chicago in 1893. The original document is entitled *Trois Projets de Nomenclature des Maladies. (Causes de Décès—Causes din Capacite de incapacité).*

The abstracts selected are those which relate to the full nomenclature, containing 161 rubrics or titles, the abridged nomenclatures, having respectively 99 and 44 titles, being omitted.

The original also contains a considerable number of titles in addition which apply only to the purposes of statistics relating to groups of persons employed at active labor, and refer to the causes of incapacity for such labor or duties in which they may be occupied.

Abstract of Dr. J. Bertillon's report upon Nomenclature of Diseases and Causes of Death to the International Statistical Institute at Chicago, 1893.

The International Statistical Institute, at its session of October 2, 1891, at Vienna, entrusted to us the duty of preparing for the next session a nomenclature of the causes of death. One of the authors of this proposition (Dr. Guillaume) expressed the wish (which he did not think necessary to incorporate in the report which was adopted) that two or three plans should be presented, one of which should be a resumé or condensed form of the others, so that each authority might choose a nomenclature more or less condensed without sacrificing exactness of international comparisons. The subject is by no means new.

Already in 1853 the Statistical Congress at Brussels had decided that it was advisable to "formulate a uniform nomenclature of the causes of death" and had authorized D' Espine of Geneva and Dr. Farr to present a plan of nomenclature at the next congress. In 1855 each of these two distinguished physicians reported plans founded upon very different principles.

In the committee where these two systems of nomenclature were discussed, the president, M. Rayer, called attention to the fact that the classification of diseases was a matter of secondary importance, and that the main point was to prepare a list of separate diseases (unites morbides) which were of sufficiently frequent occurrence to merit the attention of

the statistician, so that the summary of the causes of death when tabulated by separate diseases or units should always render the comparison of data possible.

It was therefore from this judicious point of view that the list drawn up in this manner was presented for the approval of the Congress. This list was translated into English by Dr. Farr, into German by M. Virchow, into Italian by M. Bertini, and into Swedish by M. Berg.

The single diseases defined by the Congress of 1855 still exist in almost all systems of nomenclature, but do not follow the classification adopted by the Congress. We find that the committee with good reason attached but little importance to this classification. To-day, as well as in 1855, the nature of diseases is too little understood for us to attempt to decide upon a natural classification of diseases. If we pretend to do this the progress of medical science would completely upset our work to the great injury of statistics to which uniformity and continuity are very essential conditions.

Must it then be said that classification is of no use, and that we must be contented with a mere alphabetical list? No, an alphabetical order is an extremely faulty method of classification, and of little practical use, since the greater part of diseases have many names; the reader being unable to tell whether *dothinenteritis*, for example, has been entered under the name of typhoid fever or mucous fever, or of continued fever, etc., would be obliged to read through the entire list in order to find the term. A classification by analogy, therefore, while very defective, is still preferable to an alphabetical list.

Most of the nomenclatures now in use are derived more or less directly from that of Dr. Farr, in which diseases are classed, for the most part, according to their anatomical seat, and not according to their nature. This is evidently right, since the progress of science constantly modifies the opinions of physicians as to the nature of diseases, and consequently, a statistical nomenclature should be modified with the least possible frequency in order to admit of comparison with those of earlier date.

The diseases of each system of organs are grouped together; for example, the nervous system, the circulatory, the respiratory, the digestive, the genito-urinary, the affections of the skin, and those of the organs of locomotion (the bones, joints, muscles.)

Beside these diseases, the seat of which is known, there are others which involve the whole organism; formerly these general diseases were separated into several sub-divisions which to-day are out of date. It is better to group these diseases together, placing at the head of the list those to which Dr. Farr gave the fortunate title of "zymotic"; then those which are termed "virulent"; finally, other general diseases and slow poisons. But it would doubtless be a mistake to make these distinctions in a new nomenclature, since we can to-day foresee that they will soon lose the importance which was once attached to them. For

example, at the present day the list of diseases called infectious includes additional diseases which were once classed under other titles. It is better, then, to avoid these classifications which are necessarily only provisional, and are also useless for statistical purposes.

As many of the speakers at the statistical congress at Paris, and other distinguished authorities, have said, the important point in medical statistics consists in the presentation of the relative figures for a certain number of definite diseases. With the same intent, the authors of the Italian nomenclature have omitted all the titles (of general groups.) However much we may approve the motive which actuated them, we maintain some of the general titles for the sake of facilitating scientific research.

The preceding statement explains why, in the compilation of the abridged nomenclatures, we were not concerned about general titles covering a group of diseases. We believe that, in the present state of medical science, we should not attempt to establish a definite grouping of diseases. What significance can be attached to-day to the terms "enthetic, dietic, diathetic" diseases which Dr. Farr proposed for the adoption of the statistical congress of 1855? They have lost all their meaning, and a statistical system which informs us to-day, for example, how many persons died of "diathetic diseases" conveys but little meaning. But, if the name of the group or sub-division has lost its meaning, the name of the separate disease still preserves its significance; for example, this group of diseases, the "diathetic," was made up of gout, anemia, cancer, and senile gangrene. These diseases which seem to us to-day so grotesquely associated, when considered separately still preserve very definitely the meaning which they had in 1855.

The history of the past should be our light in the future. Those disease groups which once seemed most natural have rapidly lost their alleged value. We cannot, then, employ them in medical statistics if we aim at permanent work. On the contrary, the meaning of separate diseases changes much more slowly.

It is for this reason then, that when we compile abbreviated nomenclatures, we shall not attempt to bring together (under a generic term) several diseases which seem to us to be related to one another since we may fear that in a very few years this grouping may become artificial and out of accord with the progress of medical science. It appears much preferable to us to retain, in an abridged nomenclature, those definite diseases which are most worthy of study, partly on account of their transmissible nature and especially on account of their frequency.

Resumé.

The foregoing considerations doubtless justify the method of work which we have undertaken.

We have adopted the following divisions for the classification of dis-

eases, according to the opinion of Dr. Farr, after their anatomical seat, and not according to their nature:

1. General diseases.
2. Diseases of the nervous system and of the organs of sense.
3. Diseases of the circulatory system.
4. Diseases of the respiratory system.
5. Diseases of the digestive system.
6. Diseases of the genito-urinary system and its adnexa.
7. Puerperal diseases.
8. Diseases of the skin and of its adnexa.
9. Diseases of the organs of locomotion.
10. Malformations.
11. Diseases of infancy.
12. Diseases of old age.
13. Diseases or injuries produced by external causes.
14. Ill-defined diseases.

We then collected from the standard medical dictionaries (those of Littré and Robin, Mathias Duval and Lereboullet, and Maxwell), all the names of diseases which they contain, and have arranged them under each of the foregoing classes; then, with the help of the principal existing nomenclatures, we have selected the most important titles.

The nomenclatures which have afforded most assistance are those of Dr. Wm. Farr, that of the Statistical Congress of 1855, that of the city of Brussels, that of the city of Paris (1865, corrected in 1874, and again in 1880) that of Virchow, that of the kingdom of Italy, and finally the plan of the Federal Bureau of Statistics, quite recently published.

This work was completed in 1885, at the request of the Statistical Commission of Paris, which desired that the French nomenclature should be so framed as to allow international comparison as far as possible. Eight years of practical use make it possible to state that this nomenclature has successfully stood the test of experience, and that the death returns made by physicians easily find in it their natural place.

I. GENERAL DISEASES.

The following list comprises the diseases which we have arranged under the head of general diseases:

1. Typhoid fever.
2. Typhus fever.
3. Scurvy.
4. Small-pox.
5. Measles.
6. Scarlet fever.
7. Whooping cough.
8. Diphtheria and croup.
9. Influenza.

10. Miliary fever.
11. Asiatic cholera.
12. Cholera nostras.
13. Other epidemic diseases—*a.* Yellow fever; *b.* Plague; *c.* Mumps; *d.* Others.
14. Purulent and septicaemic infection.
15. Glanders and farcy.
16. Malignant pustule.
17. Hydrophobia.
18. Recurrent fever.
19. Intermittent fever.
20. Marsh fever.
21. Pellagra.
22. Tuberculosis—*a.* Of the lungs; *b.* Of the meninges; *c.* Of the peritoneum; *d.* Of other organs; *e.* General.
23. Scrofula.
24. Syphilis—*a.* Primary; *b.* Secondary and tertiary.
25. Cancer—*a.* Of the mouth; *b.* Of the stomach or liver; *c.* Of the intestines or rectum; *d.* Of the uterus; *e.* Of the breast; *f.* Of the skin; *g.* Of other parts.
26. Rheumatism—*a.* Of the joints and parts not specified; *b.* Of the meninges; *c.* Of the endocardium and pericardium; *d.* Of the pleura; *e.* Of the peritoneum; *f.* Of other organs.
27. Gout.
28. Diabetes (sacch.).
29. Exophthalmic goitre.
30. Addison's disease.
31. Leucaemia.
32. Anemia, chlorosis.
33. Other general diseases.
34. Alcoholism (acute or chronic).
35. Lead poisoning.
36. Other chronic poisons, due to occupations.
37. Other chronic poisons.

This classification differs but little from that which may be found in chapters 1, 2, 3, and 6 of the nomenclature of Berlin. It differs still less from that which is to be found in the successive numbers 9 to 43 of the Italian nomenclature. We believe that our title "tuberculosis" might be still further developed. The extreme importance attached to this destructive disease has decided us to group together all its manifestations, as in the Swiss nomenclature. Instead of this, some nomenclatures do not contain the title "Tuberculosis," and pulmonary tuberculosis is placed with diseases of the lungs; tuberculosis of the brain with diseases of the nervous system, etc., so that it becomes difficult and sometimes impossible to find out how many victims tuberculosis claims.

It seems preferable to us to give this proteiform disease a sort of special group by itself.

The German nomenclature to-day with good reason classes diphtheria with croup. The school of Bretonneau has never admitted any distinction between these two diseases and at the present day, this is the generally admitted opinion. It is very important for exactness of international comparison that the titles "Diphtheria" and "Croup" should always be placed side by side, to facilitate adding the numbers;[1] we prefer to combine them under a single title.

We have introduced changes under the title "Rheumatism."

We have not placed puerperal fever with other infectious diseases, since it would be necessary to place puerperal phlebitis, phlegmasia dolens, etc., in the same class, diseases which most likely are also infectious disease. All these diseases are inseparable from the other puerperal diseases with which they are too often confounded, under the general term "sequelae of childbirth." It is then important to make for all the diseases of pregnancy and childbirth a special class or title.

Varicella appears in the nomenclature of the Congress of 1855, in that of Dr. Farr, and in that of Berlin, but this disease is rare and is not a cause of death.

Among the general diseases we maintain tuberculosis and cancer and finally as a disease (but not as a cause of death) anaemia. Tuberculosis of the lungs should be given a distinct title, since it is the most frequent of all diseases, and that of the meninges, since this title is needed to complete those of meningitis and of convulsions.

II. DISEASES OF THE NERVOUS SYSTEM AND OF THE ORGANS OF SENSE.

The following is the list of diseases which we have placed in this group:

38. Encephalitis.
39. Simple meningitis.
40. Progressive locomotor ataxia.
41. Progressive muscular atrophy.
42. Congestion and cerebral hemorrhage.
43. Cerebral softening.
44. Paralysis without known cause.
45. General paralysis.
46. Other forms of mental alienation.
47. Epilepsy.
48. Eclampsia (not puerperal).

[1] Note:—We notice with regret that the English cities whose nosological statistics are otherwise very valuable, publish every week the number of deaths from diphtheria, those from croup being excluded. In consequence of this arbitrary distinction it follows that, from these weekly reports, one cannot obtain an exact idea of the frequency of this cause of death in England.

49. Infantile convulsions.
50. Tetanus.
51. Chorea.
52. Other diseases of the nervous system—*a.* Hysteria; *b.* Neuralgia; *c.* Other diseases of the nervous system.
53. Diseases of the eyes.
54. Diseases of the ears.

This nomenclature is nearly identical with that of Italy, with the exception of some titles but little used. But Italy classes *progressive muscular atrophy* elsewhere, the nervous origin of which cannot be doubted. It has no place for the title *cerebral softening*, notwithstanding the great frequency of this disease.

The nomenclature which we propose bears a close resemblance to those of Dr. Farr, of Berlin, and of Brussels. Following the example of Dr. Farr, we have devoted a special title to chorea; but the nomenclature of Berlin confounds this disease with epilepsy, and that of Brussels confounds it with locomotor ataxia; it appears to us to differ so greatly from these two diseases as to deserve a separate title notwithstanding the rarity of fatal cases.

We must insist upon maintaining the title *paralysis without known cause.* In fact, paralysis is often stated as a cause of death when it can only be called a symptom. But as is often the case the physician is unable to decide whether the paralysis is due to apoplexy or to cerebral softening. It may be advisable to unite these three causes of death in an abridged nomenclature. The title "Convulsions" exists in each of the nomenclatures, and it is always well filled, because of the difficulty in locating the disease which has caused the convulsions. This title should therefore be retained.

It might also be useful to introduce the title "Myelitis," in accordance with the Italian nomenclature, instead of confounding this disease under the general term "other diseases of the nervous system."

III. DISEASES OF THE CIRCULATORY ORGANS.

The following is the list of diseases which we have placed in this class:

55. Pericarditis.
56. Endocarditis.
57. Organic diseases of the heart.
58. Angina pectoris.
59. Diseases of the arteries, atheroma, aneurism, etc.
60. Embolism.
61. Varices, varicose ulcers, and hemorrhoids.
62. Phlebitis and other diseases of the veins.
63. Lymphangitis.
64. Other diseases of the lymphatic system.

65. Hemorrhage.
66. Other diseases of the circulatory system.

This momenclature, a little more extended than those of Italy, Brussels, Berlin, and the Congress of 1855, resembles more closely that of Dr. Farr. The only perceptible difference consists in the fact that we do not employ the title *syncope*. This word often means *sudden death without known cause*, a title which figures in our nomenclature among diseases the cause of which is ill-defined.

IV. DISEASES OF THE RESPIRATORY ORGANS.

The following is a list of diseases which we have placed in this class:

67. Diseases of the nasal fossae.
68. Diseases of the larynx or of the thyroid gland.
69. Acute bronchitis.
70. Chronic bronchitis.
71. Broncho-pneumonia.
72. Pneumonia.
73. Pleurisy.
74. Pulmonary congestion and pulmonary apoplexy.
75. Gangrene of the lung.
76. Asthma and pulmonary emphysema.
77. Other diseases of the respiratory organs (except phthisis).

We insist upon the distinction of *acute* from *chronic bronchitis*. These two diseases are properly separated in the nomenclature of Berlin, since they are obviously of a different nature.

We have made a special title for *broncho-pneumonia*, a disease intermediate between acute bronchitis and pneumonia. They may be united but it then becomes necessary to write the title thus, "pneumonia and broncho-pneumonia"; otherwise it could not be known whether broncho-pneumonia had been classed with acute bronchitis or with pneumonia. It was formerly so classed in the statistics of Paris, and it is at the demand of many eminent physicians that the distinction has been introduced.

The nomenclature of Berlin contains a title which, especially at both early and advanced ages, is overburdened, and which is entitled *Lungenlahmung* (paralysis of the lungs). This word does not figure in Maxwell's Terminologia and the term "paralysis of the lungs" is but little used by French authorities. It corresponds with that which we call *congestion* and *pulmonary apoplexy* (a title also found in the Italian nomenclature).

A special title may be made for *pulmonary emphysema* after the example of the German and Swiss nomenclatures. Still, according to the English nomenclature we confound emphysema with asthma, since a careful examination is often necessary to distinguish these two diseases, which, however, are quite dissimilar in their nature. The nomenclature of Brussels confounds *asthma* with *angina pectoris*, which is to be regretted.

V. DISEASES OF THE DIGESTIVE ORGANS.

The following is a list of the diseases which we have classed under this head:

78. Diseases of the mouth and its adnexa.
79. Diseases—*a.* of the pharynx; *b.* of the oesophagus.
80. Ulcer of the stomach.
81. Other diseases of the stomach (cancer excepted.)
82. Infantile diarrhea and gastro-enteritis, athrepsia.
83. Diarrhea and enteritis.
84. Dysentery.
85. Intestinal parasites.
86. Hernia, and intestinal obstructions.
87. Other diseases of the intestines.
88. Icterus.
89. Hydatid tumor of the liver.
90. Cirrhosis of the liver.
91. Biliary calculi.
92. Other diseases of the liver.
93. Inflammatory peritonitis (puerperal excepted).
94. Other diseases of the digestive organs (cancer and tubercular diseases excepted).
95. Abscess of the iliac fossa.

This nomenclature is much like those of Berlin and of Italy. It is a little shorter than the English and may be considered as a compromise between the three nomenclatures.

VI. DISEASES OF THE GENITO-URINARY ORGANS AND THEIR ADNEXA.

The following is a list of diseases which we have placed in this class:

96. Acute nephritis.
97. Bright's disease.
98. Perinephritis, and perinephritic abscess.
99. Renal calculus.
100. Other diseases of the kidneys.
101. Vesical calculi.
102. Diseases of the bladder.
103. Diseases of the urethra.
104. Diseases of the prostate gland.
105. Diseases of the testicle and its membranes.
106. Other diseases of the male genital organs.
107. Pelvic abscess.

Diseases of the Uterus:

108. Periuterine hematocele;
109. Metritis.
110. Uterine hemorrhage (not puerperal);

111. Non cancerous tumors.
112. Other diseases of the uterus.
113. Ovarian cysts and other tumors of the ovary.
114. Other diseases of the female genital organs.
115. Non puerperal diseases of the breast (cancer excepted).

The nomenclature of the diseases of the urinary organs is nearly the same in all countries. After the example of Italy and Switzerland we have made no special title for *uremia* because it does not constitute a distinct disease but is only a consequence of Bright's disease. Since it may also result from diseases of the bladder, the English and German nomenclatures have given it a separate title (perhaps not without reason).

The diseases of the male genital organs are not, in any nomenclature, presented with more detail than in ours where only two titles are given to them.

Those of the female genital organs present greater difficulties. After the example of the English nomenclature we make a distinct title for pelvic abscess. Ovarian cysts deserve a separate title. We have given special titles to the most common diseases of the uterus, metritis, or rather the collection of diseases which a superficial examination confounds under this name, non-puerperal hemorrhage, and lastly non-cancerous tumors which so often have their seat in this organ. These different diseases are found in the Italian nomenclature, but are confounded in the same parenthesis. Other diseases of the uterus are confounded under one general title.

Following the example of the Italian nomenclature we place the non-puerperal diseases of the breast after the diseases of the female genital organs.

VII. PUERPERAL DISEASES.

The following are the diseases which we have placed in this division:

116. Accidents of pregnancy.
117. Puerperal hemorrhage.
118. Other accidents of delivery.
119. *a.* Puerperal septicæmia; *b.* puerperal phlebitis.
120. Puerperal metroperitonitis.
121. Puerperal albuminuria and eclampsia.
122. Puerperal phlegmasia alba dolens.
123. Other puerperal accidents (sudden death).
124. Puerperal diseases of the breast.

We distinguish I. The accidents of pregnancy. II. Those of delivery. III. Those which may follow delivery. Several nomenclatures make a special title for extra-uterine pregnancy; in our opinion this phenomenon is too rare to deserve a separate heading; puerperal hemorrhage, on the contrary, is a frequent accident.

The exact limits of puerperal septicæmia have not yet been traced; the existing tendency is to attribute to the principle of infection a great num-

ber of accidents which were formerly believed to be independent of puerperal fever. This point not being scientifically determined, statisticians should take pains to make special titles for the more frequent of these accidents in the future, and when it shall become known where they belong, it will always be possible to add together the figures which follow each of these titles. We propose, therefore, to introduce special titles for the following diseases: 1. Septicæmia. 2. Phlebitis. 3. Metroperitonitis. 4. Puerperal albuminuria and eclampsia (diseases which perhaps are not identical). 5. Phlegmasia alba dolens. 6. Other accidents.

In our opinion, it would be unfortunate not to place these titles near together, and to transfer some of them to the infectious diseases. We do not yet know, in fact, what diseases among these are of bacterial origin; some physicians willingly apply this title to them now, and no one knows just where we shall find them in the future.

Moreover, many diagnoses are practically incomplete. Many women are registered as dead from the "accidents of childbirth," no indication being presented whether death was caused by infection. We shall know that the figures placed at the end of the titles which we have made will be incomplete; and the title "other and ill-defined causes" will show to what extent they are incomplete. It is important then, that this auxiliary title should be near to those which it completes.

VIII. DISEASES OF THE SKIN AND OF THE CELLULAR TISSUE.

The following is the list of diseases which we have placed in this class:

125. Erysipelas.
126. Gangrene.
127. Anthrax.
128. Phlegmon (acute abscess).
129. Other diseases of the skin and its adnexa (cancer excepted).

Erysipelas, anthrax, and also phlegmon are classed to-day as infectious diseases, but, since these diseases affect only the skin and its adnexa, there is no advantage in classifying them as general diseases since they are not general diseases. All the nomenclatures take this course, so far as anthrax and phlegmon are concerned; they are less unanimous regarding the position of erysipelas. Moreover, the figures which represent this disease are always incomplete, since it is very often nothing but a complication of some other disease.

IX. DISEASES OF THE ORGANS OF LOCOMOTION.

The following is the list of diseases which we have placed in this class:

130. Pott's disease.
131. Chronic or cold abscess.
132. Other diseases of the bones.
133. White swellings.
134. Other diseases of the joints.

135. Amputation.

136. Other diseases of the organs of locomotion.

Among the diseases of the bones, we have given a separate place to Pott's disease (according to the Italian nomenclature). In our opinion it would be a mistake to classify this disease with tuberculosis, since it appears that Pott's disease may not be tuberculosis.

Among the diseases of the joints we have also given to white swelling a separate place.

We are compelled by the neglect of a few physicians to introduce the title "amputation." Amputation is not a disease and ought not to be considered as a cause of death, since it is, on the contrary, an operation designed to prevent death. But it often happens that medical men, instead of stating definitely the disease or lesion which has made the amputation necessary, write simply the word "amputation".

X, XI, XII. MALFORMATIONS—DISEASES OF THE EXTREMES OF LIFE.

The following are the diseases which we have placed in these classes:

137. Malformations.

138. Congenital debility, jaundice, and sclerema.

139. Neglect.

140. Other diseases of infancy.

141. Senile debility.

Since malformations even though congenital, may cause death at later periods of life they should be placed in a separate class.

XIII. DEATHS BY VIOLENCE.

We have placed the following list of causes in this class:

142. Suicide. *a.* By poison; *b.* by asphyxia; *c.* by strangulation (hanging); *d.* by drowning; *e.* by firearms; *f.* by cutting instruments or weapons; *g.* by precipitation from a height; *h.* by crushing; *i.* by other methods.

143. Fractures.

144. Dislocations.

145. Other accidental wounds.

146. Burns.

147. Sunstroke and freezing.

148. Accidental drowning.

149. Starving.

150. Inhalation of poisonous gases (suicide excepted).

151. Other accidental poisons.

152. Other methods.

The different modes of death by violence are many in number; we have selected those which are the most frequent, and have presented titles which are sufficiently comprehensive, so that any one may, without difficulty, classify any unforeseen cases which may occur.

XIV. ILL-DEFINED DISEASES.

It often happens that the physician cannot state definitely the cause of death, and is compelled to give as the cause some symptom which is common to several different diseases. This frequently happens, for example, in cases of sudden death. It may be apoplexy, it may be the rupture of an aneurism, it may be angina pectoris or possibly some other disease which has caused death. The physician cannot ascertain the cause, and therefore writes upon the certificate the words "sudden death." Statistics would deprive us of important information if these deaths were to be confounded with those from "unknown or unspecified causes." Titles should therefore be given to them. We propose the following:

153. Exhaustion. Cachexia.
154. Inflammatory fever.
155. Dropsy.
156. Asphyxia; cyanosis.
157. Sudden death.
158. Abdominal tumor.
159. Other tumors.
160. Ulcers.
161. Unknown or unspecified causes.

RULES TO BE OBSERVED IN DOUBTFUL CASES.

The following are the general rules which we have adopted for the solution of certain difficulties (most frequently caused by incomplete diagnoses, notably in the hospitals).

I. Incomplete Diagnosis.

1. It is not the duty of a statistical office to interpret diagnosis (that is to say, to guess at what has been left incomplete). It can only register facts as they are formulated.

2. When an organ affected with disease is not specified the certificate should be entered under the title "other organs."

For example:—if the physician writes as cause of death "cancer," without specifying the organ attacked, the certificate should be classed under the title of "cancer of other organs."

3. An operation upon an organ (without specification of the cause which has necessitated the operation) leads us to suppose that this organ was diseased. Consequently, for lack of better information, a certificate, in which the only cause of death noted is an operation upon an organ, should be recorded under the title "other diseases of this organ."

For example:—Hysterotomy, given as a cause of death without other and more definite information, implies a diseased uterus. Hence the certificate which conveys this information should be classed under the title "other diseases of the uterus."

II. *Doubtful Diagnosis.*

1. In doubtful cases, greater importance is attached to the seat of the disease than to its nature. For example :— for "abscess of the prostate" there is no special title : it should be classed under "diseases of the prostate" and not under "abscess."

2. The presence of a foreign body in an organ should be considered as a disease of that organ. For example :—A foreign body in the bladder given as a cause of death should be classed under the title "diseases of the bladder." Nevertheless a "a foreign body in the larynx" or in the "trachea" is to be considered as a cause of death by violence, and should be classed under that title.

III. *Choice Between two Simultaneous Diagnoses.*

Another question remains to be decided. It very often happens that two diseases are named at the same time as the causes of death : to which of these causes shall the death be attributed? The following rules are presented to solve this question :

1. When death is attributed simultaneously to two diseases, it should first be ascertained whether one is not a complication. If this is found to be the case then the death must be classed under the primary cause. Examples :—

Measles and convulsions, record as measles.
Measles and broncho-pneumonia, record as measles.
Scarlet-fever and diphtheria, record as scarlet-fever.
Scarlet-fever and nephritis, record as scarlet-fever.
Scarlet-fever and eclampsia, record as scarlet-fever.
Diabetes and bronchitis, record as diabetes.
Typhoid fever and pulmonary congestion, record as typhoid fever.
Whooping cough and pneumonia, record as whooping cough.
Cerebral hemorrhage and hemiplegia, record as cerebral hemorrhage.
Felon and purulent infection, record as felon.

2. If it is not absolutely certain (as in the preceding cases) that one of these diseases is the result of the other, the question should be settled whether there is not a considerable difference in the severity of the two diseases, and then the death should be recorded under the title of the more dangerous disease. For example : Cirrhosis and fracture of the leg. One of these diseases is not the cause of the other. Cirrhosis being fatal, and fracture of the leg only exceptionally so, the death should be recorded as from cirrhosis.

A still more puzzling example : Measles and phthisis. There is no proof that measles has been the cause of a given case of phthisis (although it may have hastened its progress). Phthisis being a more severe disease than measles, the death should be recorded under the title "phthisis."

This second example shows that the rule occasions some difficulties.

The following suggestions may be adopted in certain doubtful cases: Deaths recorded as from:

Measles and diphtheria, record as diphtheria.

Measles and small-pox, record as small-pox.

Measles and whooping-cough, record as measles.

Apoplexy and senile debility, record as apoplexy.

Heart disease and softening of the brain, record as heart disease.

Cancer and pulmonary phthisis, record as cancer.

3. If the two causes of death are equally fatal, and neither appears to be caused by the other, the death should be recorded under that title which describes the case with the greatest accuracy. Generally it is the more rare disease, and this is the name which the physician usually writes first. For example: Diabetes and tuberculosis, record under diabetes.

The foregoing rules have been adopted for many years in the statistical service of the city of Paris. They have also been adopted for eight years in all the French cities having more than 5,000 inhabitants in each. They have served to give a definite meaning to each of our titles. Their application has rarely occasioned actual difficulties, all ordinary cases being settled beforehand.

A PROVISIONAL ARRANGEMENT OF CAUSES OF DEATH.

By CRESSY L. WILBUR, M. D.,

Division of Vital Statistics, Department of State, Lansing, Mich.

The most common classification of causes of death employed in registration reports, that of Dr. Farr, either in its original form or as modified in the later English reports, has a most portentous, and, to the layman, appallingly scientific, appearance. The terms designating the classes and orders—zymotic, constitutional, developmental, miasmatic, enthetic, zoögenous, and the like—seem pregnant with occult meaning, and it is not until the student learns that the nomenclature employed represents the scientific theories of a former generation, and is widely at variance with our knowledge of the causation and relationship of disease at the present day, that he begins to realize that this once useful nosological arrangement has lingered too long upon the scene of action, and is now rather an encumbrance than a help in the statistical study of disease.

Some of the terms of this system are not only obsolete, at least in the meaning originally assigned them, but the classification is too extended and cumbrous to yield the best practical results. It repels and discourages many who would make use of a brief, clear statement of causes of death, and hopelessly encumbers the pages of the registration reports with data concerning unimportant and trifling causes, while the really important facts are difficult to find in the excess of insignificant details. Registration reports should be so constructed that they shall be plain to the comprehension, and convenient for the use of non-medical readers, and also of the rank and file of the medical profession who have had no special training in medical statistics. Too extensive and minute a classification of causes of death defeats its own object, the presentation of such causes in their true relations and proportions.

Our most pressing necessity in Michigan at the present time does not so much consist in an improvement in methods of tabulation and statement of results, as in a radical change in the method of collecting the primary elements of registration. Perhaps forty per cent. of the actual number of deaths that occur each year in the state is unrecorded on account of the imperfect method of enumeration by supervisors some time after the close of the year in which the deaths occurred, instead of their immediate registration. We have reason to hope that some action may be taken by the legislature at its session this winter in the direction of a thorough revision of the registration law; in fact a strong committee has already been appointed by the State Medical Society for that purpose. When such action shall have been taken, and a satisfactory registration law shall have gone into practical operation in this state, we shall be

confronted by the question: In what form can the results of registration of causes of death be thrown in order to be of most interest to the general public, most suggestive to the medical profession, most helpful to the sanitarian, and most readily comparable with corresponding data from other states and countries? These, I take it, are the principal objects of the registration of deaths, apart from its legal importance.

There is not at present a uniform and satisfactory system of tabulating causes of death in use in the registration reports of America. Examination of the prominent reports for any special purpose, (I have recently attempted to collect the evidence relating to the prevalence of a few of our most important diseases,) discloses the presence of many dangerous pitfalls for the unwary, caused by varying forms of compilation and by different meanings attached to what is apparently the same term. These can be removed from the registration reports of a single state; by permission I shall show you what I have attempted to do in a tentative way to make the reports of Michigan simpler and of greater practical value, but a general change can only be brought about by the united action of the registrars of this country, state and municipal, and this very desirable object I hope may be effected through this Association.

Following is a tabular statement, of the separate causes of death from important diseases, used in the tables of the Michigan registration report now in press, with the total number tabulated under each head also stated, in order to show their distribution in practice. It must be remembered that the Michigan returns are very imperfect as regards statement of cause of death, the enumeration being made by non-medical men, and without requirement of physicians' certificates. Also, that deaths from violence and still-births are treated in separate tables, although included in the total number of deaths. Some explanatory remarks printed in connection with these tables are also, by permission of the publication committee, presented substantially as they will appear in the report:

Provisional Tabular Arrangement of Important Diseases and Groups of Diseases returned as Causes of Death in Michigan, 1892.

No. of line.	CAUSES OF DEATH, 1892.	State.
1	TOTAL DEATHS	21,729
2	SPECIFIED DISEASES	17,578
3	*Dangerous communicable diseases*	*5,029*
4	Consumption	2,080
5	*Other tubercular diseases*	*208*
6	Marasmus	109
7	Meningitis, tubercular	33
8	Scrofula	17
9	Tabes mesenterica	37
10	Other forms of tuberculosis	12
11	Croup	211
12	Croup, membranous	80
13	Diphtheria	1,020
14	Erysipelas	64
15	Fever, puerperal	42
16	Fever, scarlet	442
17	Fever, typhoid	626
18	Fever, typho-malarial	23
19	Fever, typhus	6
20	Glanders	1
21	Measles	72
22	—German (Rötheln)	2
23	Small-pox	1
24	Chicken-pox	4
25	Whooping-cough	147
26	*Bladder diseases*	*50*
27	Calculus	11
28	Cystitis	22
29	Bladder disease, etc	17
30	*Bowel diseases*	*1,631*
31	Bowels, inflammation of	334
32	Diarrhea	277
33	Cholera infantum	606
34	Dysentery	74
35	Peritonitis	89
36	Bowel disease, etc	251
37	*Brain diseases*	*1,534*
38	Apoplexy	219
39	Brain, congestion of	68
40	Brain, inflammation of	292
41	Epilepsy	62
42	Meningitis	148
43	Paralysis	571
44	Brain disease, etc	174
45	Cancer	558
46	Tumor	139
47	Childbirth	244
48	Convulsions	548
49	Diabetes	69
50	Dropsy	389
51	Fever	129
52	Fever, malarial	146
53	*Heart diseases*	*1,329*
54	Pericarditis	97
55	Heart disease, etc	864

Provisional Tabular Arrangement of Important Diseases and Groups of Diseases returned as Causes of Death in Michigan, 1892.

No. of line.	Causes of Death, 1892.	State.
56	"Heart failure"	368
57	Influenza	907
58	*Kidney diseases*	*442*
59	Kidneys, inflammation of	332
60	Kidney disease, etc	110
61	Liver disease, etc	121
62	*Lung diseases*	*1,765*
63	Asthma	65
64	Bronchitis	184
65	Pleurisy	30
66	Pneumonia	1,298
67	Lungs, congestion of	87
68	Lung disease, etc	101
69	Rheumatism	149
70	Septicæmia	167
71	Spine disease, etc	94
72	*Stomach diseases*	*178*
73	Stomach, inflammation of	53
74	Stomach disease, etc	125
75	Syphilis	11
76	Unclassified*	1,949

* Includes 1,079 deaths from "old age," 223 from "debility," etc.

OBJECTIONS TO DR. FARR'S CLASSIFICATION.

Dr. Farr's system of nomenclature and classification of causes of death, as approved by the International Statistical Congress held in Paris in 1855, is substantially that employed in the registration reports of Massachusetts, New Hampshire, Ohio, Rhode Island (with modifications from the later classification), Vermont, and Michigan up to the present report. It is also in use in many municipal registration reports in various states. From the time of its introduction into the English registrar-general's reports to the year 1883, it had undergone certain changes as applied in different tables, so that the registrar-general states that for some years prior thereto, "three different classifications of the assigned causes of death had been used in the annual reports from his office." Such condition of the classification, "having this great defect, that the headings with special names, in many cases, did not stand for precisely the same causes of death as identically similar headings in other tables," was the reason that impelled the registrar-general to introduce in 1883 (Abstracts for 1881), a new and uniform arrangement which has been generally adopted in the English colonies and in some of the states of this country. Among these may be mentioned Alabama, Connecticut, Minnesota, Washington, and West Virginia. The province of Ontario uses a condensed form of the old type. Now, when we see the terms of

the Farrean system employed, such as "zymotic diseases," "constitutional diseases," etc., we have to consider, before we compare them, whether the city or state, in whose reports they appear, makes use of the old or of the later form of tabulation. In some cases it makes little difference whether one or the other be employed, but in others the variations are of sufficient importance to be worthy of consideration. Thus in the old form of classification, croup was ranked among the "miasmatic" diseases of the "zymotic" class. The registrar-general placed croup, "in deference to the classification of the College of Physicians," but with some personal protest, among "local diseases," in which place it appears in the latest English reports. To-day the tendency is to consider fatal cases of croup, especially if stated to be "membranous," as diphtheria. In the Connecticut registration reports, "membranous croup" is classed with diphtheria, while "catarrhal croup" accompanies bronchitis, pneumonia, and other diseases of the respiratory organs, supposed, at the time of the formation of the classification, to be non-specific in character. In Michigan we receive no returns of "catarrhal croup," but few of "spasmodic croup," and about one third of the total specified as "membranous croup." It is a fair presumption that a large proportion of the remaining cases of "croup" (not otherwise specified) are diphtheritic in character. It would be a distinct retrogression, were we, in the Michigan reports, to separate croup from its close connection with diphtheria, as would be necessary in strict adherence to the prevailing English nosological arrangement.

There are many reasons why Dr. Farr's classification, even in its latest type as exemplified in the English registration reports at present, is unsatisfactory, and why it should be exchanged for a better one as soon as we shall have such an arrangement properly prepared and authoritatively introduced. The old terms designating the orders and classes of causes of death have become largely obsolete, and are misleading, even, in some cases, with our present etiology. Dr. Abbott, in a paper before the Massachusetts State Medical Society some two years ago, made certain severe strictures on the terms employed in the Massachusetts reports (the old system of Dr. Farr), some of which are equally applicable to the latest form of that classification. He says, with much force:[1]

"In the class of deaths from developmental causes, *old age*, for example, a most common term in death certificates, cannot be called a cause of death, much less a disease. It is simply a period of life, and the use of the term in certificates is simply a confession of our inability to give an exact statement of the true cause.

"The first question I have to propose is whether the term *zymotic*, as a general name of the first class or division, may not be supplanted by some term which is better adapted to the progress of medical science.

"Does the term *miasmatic* properly describe the diseases of the first group of Class I?

"In Class II of the list now in use (constitutional diseases) may be found the most destructive of all diseases in our climate and in our state (tuberculosis). It was placed

[1] Medical Communications, 1892, vol. xv, p. 747.

in this class according to the belief of the profession of fifty years ago. Does not modern observation, and more intimate knowledge of its history, require that it should be placed in the First Class with other infectious diseases?"

This last objection, were the others of even less weight, will lead to the discontinuance of Dr. Farr's classification as an approved form for expressing the results of registration. The shifting of such a large number of deaths, as are annually recorded in most of the registration reports using this system, from "constitutional diseases" to "zymotic diseases," will quite alter the relations of these classes, and when cancer, dropsy, diabetes, and rheumatism (diabetes and rheumatism are in this class according to the later, but not the earlier, arrangement; dropsy was removed from this class, by the later classification, to the class of "ill-defined and not specified causes"), are also removed from "constitutional diseases," we shall have practically nothing at all left in that class.

"Developmental diseases" will undergo almost as great a shrinkage as "constitutional diseases" from recognition of the facts that "old age," "still-born," "debility," "infantile," and "teething" are practically equivalent to a return of unknown cause of death. It is true that returns of "old age," and "still-born" carry some information in regard to ages of decedents, and that ages of decedents convey some suggestion as to possible modes of death, but these are better studied in the tables specifying ages of decedents in which the influence of age can be studied in all alike.

There will be left of the five classes of the original form probably only three, zymotic, and local diseases, and deaths from violence. Even of these, the first class, zymotic diseases, will probably be otherwise designated (perhaps as specific infectious diseases), and will include many causes of death that are now classed among the local diseases. We shall then have an arrangement somewhat as follows:

A.—Deaths from Disease:

I. *Specific infectious diseases*, including small-pox, enteric fever, yellow fever, diphtheria and croup, measles, scarlet fever, malarial fever, tuberculosis (in all forms), whooping-cough, influenza, pneumonia, cerebro-spinal meningitis, erysipelas, septicæmia, Asiatic cholera, dysentery, leprosy, glanders, actinomycosis, rabies, tetanus, possibly cancer, syphilis, and all other diseases of which the chief etiological factor is one or more vegetable or animal micro-organisms.

II. *Local or organic diseases*, consisting of all those diseases dependent chiefly on changes in the anatomical or functional constitution of the body, and not due to a specific infection.

B. Deaths from Violence: either (1) accidental, (2) homicidal, or (3) suicidal.

Deaths in which the cause is unknown or unspecified may be included

in total deaths, but cannot be assigned to either deaths from disease or deaths from violence. Under an efficient system of registration based upon physicians' certificates, such deaths become of very slight importance numerically. Still-births and premature births are, practically, deaths in which the causes, whether affecting the fœtus directly, or through the mother, are not distinguished. They may be included in, or excluded from, total deaths (the latter is the prevailing practice owing to the imperfect registration of still-births in many places), but for practical sanitary use of mortality statistics they should be uniformly excluded. The basis of reference in stating the percentage relations of deaths from any specified disease, is properly the total number of deaths from *specified diseases*, deaths from violence, unknown causes, still-births, and premature births excluded.

BASIS OF PROVISIONAL CLASSIFICATION OF CAUSES OF DEATH EMPLOYED IN THE MICHIGAN REGISTRATION REPORT.

In the tables in this report the above arrangement has been introduced but partially, and the class of specific infectious diseases distinguished, includes only those "dangerous communicable diseases," as defined by the state law, which are in process of restriction by the State Board of Health. It is very desirable that the registration offices of this country unite upon some uniform, modern system of classification, but until this is done it would seem premature to introduce any formal arrangement beyond that required by the actual necessities of registration in this state.

While it seemed imperative, in the preparation of these tables, to recast them so that they should be uniform and consistent with themselves in the facts stated, it was not an easy matter to decide upon the actual changes to be made. Condensation seemed equally desirable with uniformity, in order that the facts concerning the most important causes of death might not be buried in a mass of unimportant details, and that thus the data derived from the state system of registration might become of greater utility than heretofore to the people of the state.

Were there at present a modern and generally accepted statistical classification of diseases in use, the matter would have been much simplified. The objections to the employment of the later English arrangement, which has at present the greatest vogue, have already been stated, and it seemed unadvisable to go to the labor of throwing the tables into a form which will probably be radically altered in the immediate future. Recognizing, therefore, the fact that no satisfactory nomenclature and classification of causes of death is available, and that there appears to be no immediate prospect of such a classification being introduced into practical use among registration reports, a *temporary or provisional plan* was adopted which should have reference to the special necessities of the registration of deaths in this state, and to the practical uses likely to be made of such statistics by the Michigan public health service. In the preparation of

the new tables, the following principles were followed, with such variations as seemed to be required by special exigencies :

1. A statistical classification of diseases registered as causes of death should be as succinct as possible, without confusion of distinct diseases.

2. Statements in regard to definite diseases are more important and more reliable for general purposes of comparison than those in regard to groups of diseases.

3. The tables should be arranged with especial reference to the principle uses which will be made of them. As a rule, the data contained are most valuable for reference by public health officers, and, therefore, should give especial prominence to such diseases as are in course of restriction by the public health service.

4. The classification must bear reference to the source of the returns, and the probable amount of error in the original statements received by the compiling office. When the returns are made by non-medical enumerators, as in Michigan, we can feel sure of only the plainest and most easily recognized characters. When based upon physicians' certificates, and especially if the central registration office correct all doubtful returns by correspondence, the statements are more valuable, and finer distinctions may be made.

5. Where forms of disease are definitely distinguished in only a small portion of the returns, it may become necessary to make statistical divisions on more comprehensive, although more indefinite, lines.[1]

6. It is important that the completed tables shall show certain indefinite returns, in order that the possible amount of deficiency in definitely specified diseases on account of such imperfection of registration may be inferred.

7. While various classifications of causes of death may be usefully employed in the same report to exhibit special features of mortality, some one principal arrangement should be chosen which should be carried out uniformly in a complete series of tables, exhibiting the essential statistical relations of the deaths registered from all points of view. In these tables, the same term should always refer to the same disease or group of diseases, and in case of a change in methods of classification, tables should be prepared of corresponding form for all preceding years of

[1] As an example take the case of heart diseases. Out of a total of 864 deaths from heart diseases (not including "heart failure") returned in Michigan for the year 1892, not less than 798 were reported as "heart disease" without any other qualification. There were 6 deaths returned from fatty degeneration, 8 from hypertrophy, etc. Now if these definite forms were separately stated, their number would not only be too small for any valuable conclusions to be drawn, but the average reader would be in danger of concluding that only the small numbers of definitely specified forms of heart disease had occurred, not considering that many more are included in the general term "heart disease." For this reason the tables state the deaths from "heart disease, etc.," which includes with the number specified only as "heart disease," the definite forms of heart disease referred to in the text on that subject. This is, of course, only a provisional arrangement, and is subject to change whenever the registration of causes of death improves in precision sufficiently to warrant finer distinctions. In the meantime, the numbers of all definitely specified causes of death, however small, are preserved for reference (at present, by means of the Alphabetical List).

registration, in order that comparisons may be readily and accurately made.

CONCLUSION AND RECOMMENDATIONS.

I have thought that the foregoing remarks, and the crude tabular arrangement to which they related, might have some interest for the members of this Association, if only in the direction of indicating the necessity of some systematic effort by competent and authorized persons to supply the deficiencies in the present systems of statistical classification of causes of death. There are already two committees in the field for that purpose, one a special committee of the Royal College of Physicians of England; the other a sub-committee of the International Medical Congress, of which Dr. J. S. Billings is the chairman. While we may expect material aid from the labors of these committees, it is by no means a foregone conclusion that the results reached will be the best adapted for practical use in the registration reports of this country. In fact, I believe that no class of men is so well fitted to produce a satisfactory system of classification as the registrars themselves, who know by practical experience the many difficulties to be provided for in handling causes of death, *as returned*, in order to obtain truthful and intelligible results. This remark applies where such returns are based upon physicians' certificates, and in communities where a comparatively high standard of medical education prevails. Much more is it true in certain quack-infested regions of the country where the statements of causes of death, as returned, are often beyond the comprehension of man.

In a personal letter from Dr. Billings, he says: "In the course of a year or two, however, I hope that we may have a system that we can all agree upon, and when the report of the Royal College of Physicians is published, I think it would be very desirable to have a conference of state registrars of vital statistics in this country in order to agree upon some uniform system if possible." To this remark I most heartily subscribe, adding only a wish that the principal municipal registration bureaus may also be represented, and I wish further that a permanent representative organization of the state and municipal registrars of this country could be effected in order to take concerted action upon this and many other points of importance in practical statistical work. Such are the essential principles to be regarded in the establishment of a system of registration of deaths, of great importance to states preparing to establish a system of registration, or, as in Michigan, where the present system requires radical reform in order to obtain satisfactory results; the forms of tables, and the fundamental facts that should be included in every registration report; the secondary tables containing ratios of various kinds intended to display the fundamental facts in more convenient or intelligible form; proper methods for the estimation of population and for the statement of vital rates; in short, relating to a multitude of

details in which it is highly important that there should be uniformity, and whose condition at present is simply chaotic. A National Association of Registrars of Vital Statistics would lead, also, to many indirect results of value. A greater feeling of the responsibility and dignity of the work would be encouraged, and men of special fitness be sought therefor, not considering such positions, as at present in many places, merely the temporary spoils of office which any partisan capable of reading and writing is competent to fill.

Vital statistics is nothing if not a comparative science. The results of registration in a state or city are so many meaningless figures until the touch-stone of *comparison* is applied, which tests their value, and interprets their meaning. In no way can the officials charged with registration work better keep in touch with progress, than by the closer association and more devoted feeling for their work that would be developed by contact with others working in the same direction, by the full exchange of publications, and by the establishment of some organ in which current statistical opinion and important data could be communicated. None of our state registration systems is perfect. Some of them, especially those in the few western states that have any at all, are very imperfect, but I believe it to be a fact, as I stated in a paper read at the last session of the Michigan State Medical Society[1], that upon the comparative study of the results of our state registration systems, imperfect as they are, nearly all our knowledge of the vital statistics of the United States, as a whole, during inter-census periods depends. In fact, as there pointed out the indications in regard to the *variations* in mortality from 1880 to 1890 were probably more correct than those derived from the United States census mortality statistics.

I look forward, with certainty, to a future when vital statistics will be regarded as an important and honorable branch of the medical profession, and be cultivated as a necessary preliminary to a satisfactory health administration of the city, the state, and of the nation—of the nations, indeed, I should have said, for there are no political boundaries in science. This Association was well founded as the American Public Health Association, for with the increasing ease of communication, especially with our southern neighbor, a danger to the health of one is a danger to the health of all. In no less degree is an accurate and timely knowledge of the extent and prevalence of disease, such as would be furnished by a satisfactory system of registration, important to all the countries represented in this alliance. There can be no more favorable auspices, therefore, than those afforded by this Association for the improvement of the registration of vital statistics in America, and I sincerely trust that earnest efforts, whether through an association of registrars, as suggested, or otherwise, may soon be made for this purpose.

[1] Transactions, 1894; p. 213.

LAS CUARENTENAS APLICADAS Á LA VIRUELA.[1]

POR EL DR. NICOLÁS RAMIREZ DE ARELLANO, MÉXICO, MEX.

Ninguna enfermedad ha causado quisás tantos extragos en el mundo como la viruela; el número de personas que han sucumbido á concecuencia de ella es incalculable y bien conocida es la enorme proporcion de ciegas que deben la pérdida del precioso sentido de la vista á esa terrible afeccion, que cuando no mata, deja las mas desagradables huellas de su paso por el organismo.

Muy laudables son por lo mismo los esfuerzos que en todo tiempo se han hecho para impedir su aparicion ó evitar al menos su desarrollo epidémico, y con razon el ilustre Jenner aparece siempre ante nuestros ojos como el benefactor mas distinguido de la humanidad.

Pero si es verdad que la viruela constituye un verdadero azote de los pueblos; si es cierto que basta su nombre para hacer extremecer á los habitantes de las Ciudades donde aparece y con especialidad á las Autoridades encargadas de vigilar por la salud pública, preciso es, sin embargo, que las medidas que se adopten para combatirla se deduzcan claramente de los principios cientificos adquiridos, y que en ningun caso sean inspiradas por el pánico, porque entónces su exajeracion y rigor hacen que deban considerarse como injustas y vexatorias.

Al tener la honra de concurrir á las sesiones de esta benefica Asociacion, que no solo busca el adelanto cientifico sino que procura tambien que se uniformen en la América las medidas sanitarias, para que á la vez que se facilite su aplicacion, se alcancen resultados mas provechosos, me ha parecido oportuno estudiar en esta pequeña memoria el asunto relativo á las cuarentenas marítimas aplicadas contra la viruela, porque sobre el particular la práctica no es igual por todas partes.

Las cuarentenas, á mi juicio, y en esto mi opinion está conforme con la de los principales epidemilogistas, solo están justificadas cuando se trata de impedir la entrada á un pais de las gérmenes de enfermedades exóticas, pues de otra manera se hacen sufrir al libre tráfico y al comercio perjuicios de suma consideracion sin ventajas notables para los pueblos.

En efecto, cuando en el interior de una comarca se tiene ya una enfermedad epidémica, lo único que puede hacer la cuarentena marítima es que no aumenten por esta via el número de focos, pero de ningun modo que desaparezcan, lo cual solo puede alcanzarse con otros recursos, que

[1] Presented at the Montreal meeting of the Association.

tratándose de la viruela son de resultados verdaderamente maravillosos. ¿Podría acaso aparecer justificado que en un puerto ya invadido por el cólera se contiuara, sin embargo, aplicando las reglas cuarentenarias á los pasageros que llegasen de otros lugares infestados? ¿No sería de extrañar que en la India, por ejemplo, se impusieran cuarentenas á los buques procedentes de Rusia donde reina actualmente el cólera?

Creo que realmente esta práctica no podría considerarse justificada, y que por lo mismo la regla general establecida por las epidemologistas es la que debe seguirse respecto de la viruela.

Con tanta mas razon juzgo que esta es la práctica que debe adoptarse, cuanto que en la viruela su medio de propagacion único es el contagio, no siendo de temerse por tanto el grave peligro de que llegaran á infestarse las aguas, como pasa en el cólera, ó algun otro medio que la difusion de la enfermedad se verifique con suma facilidad y rapidez.

Hay que tener en consideracion tambien que las reglas de profilaxis establecidas para la viruela son de resultados seguros y que bastará que los pueblos las apliquen con rigor para que se vean líbres de las epidemias de esa afeccion á pesar de que no se recurra á las cuarentenas marítimas. La vacunacion y la revacunacion en los lugares donde fuere preciso recurrir á esta última por sus condiciones climátericas, el aislamiento de los enfermos y la desinfeccion de las ropas y objetos que pudieran haberse contaminado, he ahí los recursos con que cuenta la higiene para combatir esa plaga, pero que por fortuna, segun decia antes, son de una eficacia completa.

Para fundar esto último basta recordar que tanto en Inglaterra, como en Alemania, en varios Estados de la Union Americana, en algunas poblaciones del Canadá y en otros lugares se ha podido extinguir casí la viruela con la aplicacion de las medidas dichas, en particular de la vacuna, que con razon se tiende á hacerla obligatoria por todas partes.

No se crea, sin embargo, que porque combato la aplicacion de las cuarentenas para la viruela, pienso que no deban tomarse precauciones de ningun género respecto á los buques que lleguen á algun puerto procedentes de lugares donde reine la enfermedad á que vengo haciendo referencia. Soy de opinion al contrario que deben sujetarse á una visita rigurosa para averiguar si llegan con enfermos á bordo ó si los han tenido durante la travesía, para que en caso de que así fuere, se aislen desde luego los enfermos y se desinfecten en todo caso las càmaras donde se hubieren asistido, así como las ropas y objetos que hubieren contaminado.

Fundándome, pues, en que la viruela no es una enfermedad exótica para el continente Americano; en que para batirla disponemos de recursos eficaces, como lo comprueban los resultados obtenidos en varias Naciones, y por último en que las cuarentenas marítimas y con mas razon las terrestres, son medidas que deben restringirse hasta donde mas sea posible por los graves perjuicios que producen al comercio y al libre tráfico, soy de parecer, y así lo propongo á los Miembros de esta Aso-

ciacion para que trabajen cerca de sus respectivos gobiernos en este sentido, que en ningun caso se adopten como medidas profilácticas internacionales para combatir esa afeccion y que se substituyan por la inspeccion de los pasageros, el aislamiento de los enfermos y la desinfeccion de los objetos y lugares contaminados, poniendo desde luego en todo caso en libre plática á los pasageros sanos y exigiéndoles solo que sean vacunados los que no lo estén.

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